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DIRECT CONSUMPTIVE USE VALUATION OF ECOSYSTEM GOODS AND SERVICES IN THE BALE MOUNTAINS ECO-REGION, ETHIOPIA

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A report submitted in partial fulfillment of the requirements for
the MSc and/or the DIC.

September 2007

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ABSTRACT

The Bale Mountains Eco-Region supports a substantial array of ecosystem goods and services. Rural communities, faced with few income earning opportunities, are highly dependent on the flow of these benefits for their wellbeing. Environmental contribution to the household production of crops, livestock and forest products, is not adequately represented in policy and management strategies and as a consequence the Eco-Region is being steadily degraded. Through market-value methods, this study assesses the economic importance of ecosystem goods and services supporting agro-pastoral livelihoods. The direct consumptive use accruing to households annually is valued at US$ 1157 from crop production, US$ 228 from livestock production, and US$ 407 from forest products. Household production decisions are opportunistic to the prevalent ecological conditions but are also motivated by a subsistence level of wellbeing. The mean annual direct consumptive use value is US$ 1823 irrespective of the relative reliance on the principle livelihood sources. Motivated to meet this subsistence level, relationships are found between direct consumptive use value and household dynamics. Positively correlated with the number of people in a household, and negatively correlated with the number of non-educated household members, livelihood options are closely linked to household dynamics. Under current open-access resource management and policy structures, the annually direct consumptive use value is US$ 377,777,500 across the Bale Mountains Eco-Region population. This considerable value illustrates the economic losses that will be suffered as a result of declining environmental quality and as the primary stakeholders, the communities that rely so heavily on the environment for their livelihoods, are also those that will be impacted the hardest. This study shows that the underlying economic incentives and household dynamics of rural communities, in the context of local ecological conditions, need to be considered if conservation strategies are to be consistent with poverty alleviation and rural development goals in the Bale Mountains Eco-Region.

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ACRONYMS AND ABBREVIATIONS

BMNP	Bale Mountains National Park
BESMP	Bale Eco-Region Sustainable Management Plan
BME	Bale Mountains Eco-Region
BT	Benefits Transfer
CBA	Cost Benefit Analysis
CL	Cropland
DAP	Diammonium Phosphate
DCU	Direct Consumptive Use
DR	Discount Rate
ETB	Ethiopian Birr
EPRDF	Ethiopian People's Revolutionary Democratic Front
FG	Focus Group
FP	Forest Products
FPA	Forest Priority Area
FZS	Frankfurt Zoological Society
GDP	Gross Domestic Product
GL	Grazing Land
HH	Household
masl	metres above sea-level
MBI	Market Based Instruments
MCA	Multi Criteria Analysis
MES	Markets for Environmental Services
NOAA	National Oceanic Atmospheric Administration
NTFP	Non-Timber Forest Products
OLS	Ordinary Least Squares
PASP	Protected Area System Plan
PEV	Participatory Environmental Valuation
PRA	Participatory Rural Appraisal
RDO	Rural Development Office
RP	Revealed Preference
SNA	System of National Accounting
SOS-FARM	SOS-Sahel with FARM Africa
SP	Stated Preference
TCM	Travel Cost Method
TEV	Total Economic Value
UN	United Nations
US$	United States Dollar
WDO	Woreda Development Office
WTA	Willingness-to-Accept
WTP	Willingness-to-Pay

INTRODUCTION

The rise in global population and wealth has not only increased the demand for ecosystem goods and services, but also necessitated that this demand is met from increasingly degraded ecosystems. The Millennium Ecosystem Assessment reports an unprecedented loss of biodiversity, the continuation of which is predicted to increase poverty levels and threaten food security (MA, 2005). Thus, conservation should be regarded as a vital tool in order to meet international development goals set by the UN to be met in 2015 (see UN, 2000). The World's ecosystems, the goods and services that they provide and human development are interlinked. Trade-offs have to be made and we must decide how best to make them.

As humans strive for higher levels of welfare, their short-term, immediate demands are commonly met through the conversion of natural ecosystems into human managed land-uses. Agricultural, industrial and residential land cover dominates the developed World's landscape. This has greatly reduced the capacity of ecosystems to provide services fundamental to human welfare; those of provisioning, regulating, cultural and supporting services (MA, 2005). This wide range of complex goods and services[1] arise from the multiple interactions of the components of biodiversity. The outcome is a valuable flow of goods and services for which there is increasing scarcity, congestion and conflict as a result of human pressure (IUCN, 2005).

Despite being valuable assets and contributing to a country's economy, goods and services have not historically, been adequately represented in markets. While many tangible products are commercially exploited others are not and these, along with the more intangible services, are largely public goods. This common property characteristic has, inevitably, meant that the true economic values to society are either not accurately reflected in market prices, or are not present in markets at all. Prices have signalled inappropriate values. This market failure, and inefficient allocation of resources, has led to the overuse and exploitation of goods and services to such a level that it now threatens global economic performance and a sustainable level of human wellbeing (see H.M.Treasury, 2006).

[1] Goods and services will henceforth refer to ecosystem goods and services unless explicitly specified otherwise.

The proper valuation of goods and services is an important area of research allowing us to assess the true contribution of ecosystems to human wellbeing. This environmental value is founded in the principles of welfare theory, where an individual's wellbeing is composed of both the consumption of private goods and services, and the quantity and quality of non-market goods and services from the resource-environment system (Freeman, 2003). Values held are relative to other goods and services, and choices have to be made in the allocation of limited resources. By assessing ecosystem goods and services in economic terms, the benefits of conservation can be more adequately represented when trade-offs are made between competing uses of financial resources, whether by private land users or public policy makers.

Competing claims for financial resources, such as health care, poverty, and education are often highly politicised and publicised, compelling large portions of a country's Gross Domestic Product (GDP). Conservation efforts also require financial backing and without the proper assessment of an ecosystems contribution to economic activity, is perceived as marginal and so does not command the financial resources it deserves. Only the goods and services that enter the formal market are commonly used as economic indicators in policy and management strategies, and the costs of depletion tend to be ignored. Through ecosystem valuation, decision-makers are able to take more informed and transparent choices between competing causes. The quantified values become more accessible to mainstream economics and increasingly, we are seeing the aggregate value of goods and services being used in the justification of policy decisions and long-term financial investment in resource management and conservation initiatives (IUCN, 1998).

The proliferation of ecosystem valuation is changing the face of conservation. The protected area approach is now being complimented by a more market-oriented approach. This is reflective of a more general trend in policy away from traditional command-and-control towards incentive led approaches (EEA, 2006). These, so-called, market-based-instruments (MBI) work by establishing prices or markets for environmental services (MES), either directly or indirectly, reflecting the true social costs and so correcting market distortions and reducing welfare losses overall. The strength of this approach is that it has the potential to allow value to be realised in areas local to conservation efforts. For example, establishing resource-user groups with

enforceable property rights might create an opportunity for profitable exchange and so an incentive for more prudent management (Landell-Mills & Porras, 2002).

Those local to conservation efforts are commonly rural populations. These rural communities often depend heavily on natural resources for their livelihoods (Bishop, 1999) and are vulnerable to political, economical and socio-cultural factors that affect resource access (Vedeld *et al.*, 2004). Ecosystem valuation then becomes a foundation from which local needs, activities and dependency on natural resources can be assessed. Better assessment leads to more appropriately designed mechanisms of management, either to capture the economic values, provide incentives to conserve the resource base, or compensate for opportunities forgone. Ultimately ecosystem valuation has the potential to reduce the conflict between development and conservation goals.

STUDY CONTEXT

ETHIOPIA

Ethiopia is Sub-Saharan Africa's second most populous nation with over 75 million people in 1,221,900 km^2 (IMF, 2007). The country has a large base of natural resources for agriculture, livestock and forestry as well as undeveloped mineral resources and considerable hydropower potential (EIU, 2006). The majority of the country falls into one of two biological hotspots, with over half of the Eastern Afromontane Hotspot in the Ethiopian Highlands, and over 40% of the Horn of Africa Hotspot within Ethiopia (GEF, 2006). To protect this considerable biological diversity the Ethiopian Wildlife Conservation Organisation (EWCO) was founded in 1964 forming a network of protected areas. In addition, a number of Forest Priority Areas (FPA) were established in the 1980s. Despite these efforts, human impacts on Ethiopian natural areas have been high. Only two of the nine National Parks and three wildlife sanctuaries, were ever legally constituted (or gazetted) and the FPA were largely nominal, as forests were perceived to be for exploitation rather than protection. Furthermore, FPA plans were only partially implemented, few were demarcated and none were gazetted (GEF, 2006). This lack of effectual management was compounded by protracted civil war and political instability adding to the degradation of natural areas through rebel force occupation and the return of displaced communities into neglected National Parks.

The defeat in 1991, of the military rule of the socialist Derg (or Provisional Military Administrative Council) by the Ethiopian People's Revolutionary Democratic Front (EPRDF), ended violent political suppression and initiated extensive economic reform within Ethiopia. This reform was largely focused towards poverty alleviation, with government efforts to increase productivity and efficiency of agriculture (Abrar *et al.*, 2004). The environmental impact of continued investment in this sector is great. Ethiopia's natural forests have been subject to excessive open-access extraction and large-scale conversion to agricultural land. This degradation is exacerbated by the government ban on private ownership of land, preventing a rural-urban migration, where infrastructure is not sufficient to support an influx of people. This uncertainty of land tenure creates disincentives for the largely rural population to maintain ecosystem quality or for farmers to invest in productivity improvements that would decrease land requirements.

More recently, the federal government's attitude to natural resources has been promising. In response to continuing decline of managed agricultural land as well as natural areas, there have been several environmental initiatives adopted. In 2005 a new Wildlife Development Conservation and Utilisation Policy and Strategy was accepted uniting previously unrelated policies for wildlife, biodiversity and environmental protection, and the Ministry of Agriculture and Rural Development is implementing a national level Protected Area System Plan (PASP). With key links between human wellbeing and the maintenance of ecosystem goods and services being made, Ethiopia's renewed attitude to natural resource conservation, and particularly an emerging participatory approach to management, could prove profound for meeting both development and poverty reduction goals.

THE BALE MOUNTAINS ECO-REGION

The Bale Mountains Eco-region (BME) forms part of the Bale-Arsi massif in the south-eastern Ethiopian Highlands (Figure 1). Located in the Oromia National Regional State, the most populous province in Ethiopia and a key political battleground, the BME covers 22,176 km^2 over fourteen Woredas; Adaba, Agarfa, Berbere, Dinsho, Dodola, Gasera, Goba, Gololcha, Goro, Harenna Bulluk, Kokosa, Mena, Nensebo and Sinana. In 2001, the population was reported at 1,276,062 (ABRDP, 2001).

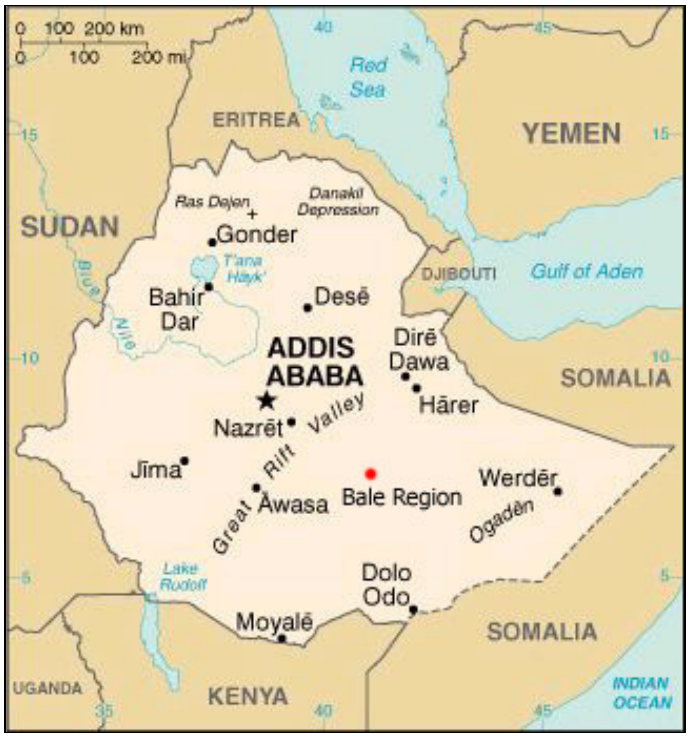

Figure 1. Map of Ethiopia and the Bale Region

The central area of the BME is a plateau at 4000 masl. South of the plateau the altitude falls rapidly with moist tropical forest between 3700 masl and 1500 masl. North of the plateau habitats comprise of woodlands, grasslands and wetlands, largely between 3000 masl and 3500 masl. The BME contains the largest area of Afroalpine habitat on the African continent and the second largest stand of moist tropical forest in Ethiopia. These habitats host a number of rare and endemic species and the Bale Mountains is one of 34 global biodiversity hotspots (Williams *et al*., 2005). This ecological importance was acknowledged by establishment of the Bale Mountains National Park (BMNP) in 1971, as well as several FPA. The BMNP, stated as one of the most important conservation areas in Ethiopia (FDRE, 2005), was actively managed until 1991 and has since become an unsustainable, open-access resource. Lack of human and financial resources, political interest and technical knowledge, combined with population growth and immigration to the area, have all contributed to the degradation of the park resources (BMNP, 2007). This pattern of unregulated exploitation is consistent over the wider BME, with rural communities rapidly deforesting to procure land for crops and livestock grazing to meet their livelihood needs (see Figure 2).

Figure 2. Natural area conversion to support an agro-pastoral livelihood in the BMNP, Rira

AIM

The aim of this study is to investigate the range and magnitude of ecosystem goods and services contributing to the welfare of communities in the BME. Through the application of environmental economics methodologies, the overall goal is to promote efficient and sustainable use of BME natural resources through provision of information to relevant stakeholders and decision-makers.

OBJECTIVES

- To identify key ecosystem goods and services providing value to BME communities.
- To acquire an understanding of the attitude and motivation of BME residents to the environment and natural resource use.
- To establish a method of quantifying direct consumptive use value derived by the BME households that can be easily replicated.
- To aggregate the value of direct consumptive use across the BME area contributing to total economic valuation of ecosystem goods and services.
- To highlight the economic importance of the BME to justify appropriate financial investment and management.

RATIONALE FOR ENVIRONMENTAL VALUATION

The BME provides a substantial flow of ecosystem goods and services to many beneficiaries. The magnitude of this flow has not been quantified and as a result, historical management decisions have not adequately considered the economic value these goods and services provide. This has lead to misallocation of resources and major ecosystem degradation. The numerous beneficiaries include discrete communities living within the BME; communities outside the BME but benefiting from values that flow over this arbitrary boundary, or travelling to BME to enjoy them; consumers of goods from the Bale ecosystem resources sold nationally or internationally; and more global consumers of ecosystem services such as hydrological systems and carbon sequestration. As such, there is no clear economic boundary for ecosystem valuation. Since this study is not of a scale that can account for all beneficiaries, it will be limited to estimating the annual value derived by the local population.

Valuation of the benefits accruing to the BME population is, arguably, of the highest priority. Primarily agro-pastoral, the communities within the BME are dependent on the ecosystem for their livelihoods. Permanent residents of the area are those that will first experience the rising costs of ecosystem decline. In addition the local population will be most heavily impacted by future policy changes and management plans in the area.

Environmental valuation will draw attention to the potential economic losses of continued degradation of the BME. It will endorse the call for improved resource management and will encourage support from government and donors. Understanding the economic incentives that are driving resource use will assess of the level of human dependency on access to these resources. This will enable a better prediction of the development impact of projects, programmes and policies to be implemented over the BME. Overall environmental valuation can greatly inform efforts to bring unsustainable resource use under control.

ENVIRONMENTAL VALUATION THEORY AND METHODS

THE THEORY OF VALUE

The neoclassical economic concept of value is utilitarian, defined in terms of contribution to the wellbeing of individuals and so rooted in welfare economics. Individuals hold preferences for different market and non-market goods for which there is a degree of substitutability and the trade-offs made between goods in the individuals' pursuit of maximum wellbeing reveal the values held for each good (Freeman, 2003). In the allocation of scarce resources between competing alternatives, this means the magnitude of the benefit, or the value, is shown by the amount the individual is willing to give up to enhance their wellbeing. Environmental valuation measures this amount in the metric of monetary units; it translates to the consumer's willingness-to-pay (WTP) for a particular benefit, or in some cases willingness-to-accept (WTA) compensation for a loss.

Using this instrumental definition of value we do not provide for the intrinsic value of ecosystems. This intrinsic value is that which resides in an environmental asset but is independent of human preference (OECD, 2006). As such, this rights-based is difficult to measure, or even approximate. According to this definition of value, individuals that believe that a species has a right to exist will have zero WTP for it's conservation, in protest of the implication that the right to exist could be traded for money. Furthermore, their WTA compensation for the loss will be infinite (Splash & Hanley, 1995). This lexicographic preference means that some reject the neo-classical assumption of widespread utilitarianism and suggest that right-based beliefs are more prevalent in society (Splash, 1997). They therefore consider that the monetarisation of ecosystem goods and services morally unacceptable.

Despite the continuing debate on the intrinsic rights of nature and the anthropocentric focus to environmental valuation (see Sagoff, 2004; Simpson, 2007), the use of instrumental value and monetarisation of it, is widely accepted. Environmental valuation methodologies grew for the purposes of assessing policy options in relation to human welfare and with globally prevalent cash economies, the money metric is widely recognised and understood by decision-makers. This familiarity greatly facilitates the

comparison of ecosystem value with other sources contributing to welfare and the economy, allowing us to make tradeoffs.

ECOSYSTEM VALUES

In order to build a more comprehensive understanding of the goods and services provided by an ecosystem, they are typically classified according to how they are utilised by humans. A commonly used framework is that of Total Economic Value (TEV). Attributed to the work of Pearce and Warford (1993), the framework divides TEV into use values and non-use values and subdivides these into categories of benefits contributing to wellbeing (Figure 3).

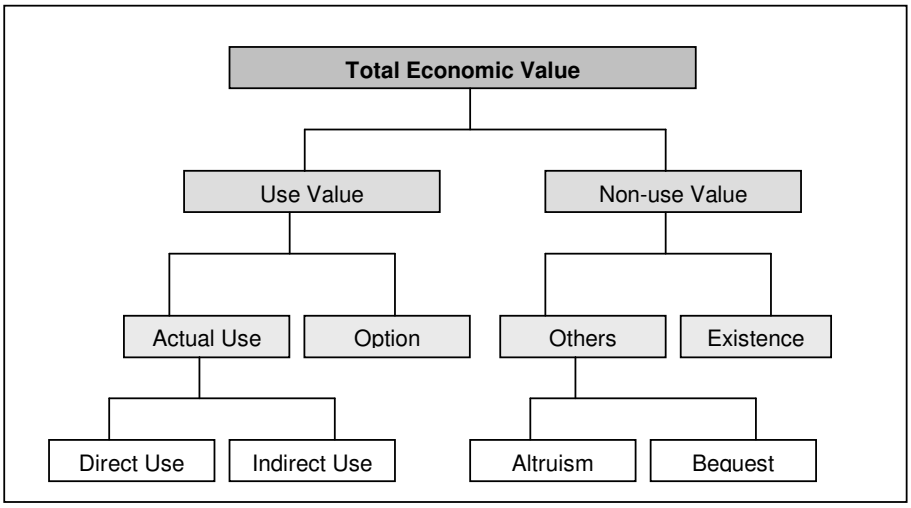

Figure 3. Total Economic Value Framework
(adapted from Pagiola *et al.,* 2005)

Use value to humans consists of direct, indirect and option value. Direct-use values can be consumptive or non-consumptive and are commonly derived from goods and services by the inhabitants of the ecosystem. Indirect-use values are those that are more functional, the benefits of which often extend away from the ecosystem itself and are not obviously consumed. Option value concerns goods and services that are not used at present, but have the potential to be used directly or indirectly, in the future.

Non-use value is the value of the continuation of the provision of a good or service even where an individual has no intention of using the resource. The satisfaction in knowledge that services merely exist is classified as existence value. The availability of

goods and services to be used by future generations is referred to as bequest value and by current generations as altruistic value.

People have long been familiar with direct uses of ecosystems such as harvesting fruits and fuelwood (both consumptive), or deriving satisfaction from a natural landscape (non-consumptive), but the services that provide indirect benefits are less familiar. These services include waste assimilation, natural disaster prevention and carbon sequestration. The acknowledgment of which are gradually becoming more commonplace in society. Even less well known, by definition, are future direct and indirect, benefits from ecosystems such as undiscovered pharmaceuticals or genes to improve agricultural productivity. These have potentially substantial benefits but also a large amount of uncertainty. Non-use values have long existed with people showing concern for threatened species or stewardship for an asset. For example, donations to environmental causes such as the World Wildlife Fund are 'employed predominantly in an effort to save exotic species in remote areas of the world which few subscribers to the Fund ever hope to see' (Krutilla, 1967: p781).

The BME provides many ecosystem goods and services that fit into this TEV framework and examples of these values are identified in Table 1.

Table 1. Ecosystem goods and services contributing to TEV in the BME

Total Economic Value				
Use Values			**Non-use Values**	
Direct use	**Indirect use**	**Option**	**For others**	**Existence**
Domestic Water	Ground water recharge	Pharmaceuticals	Species	Endemic species
Forest Products	Flood control	Genetic library	Habitats	Habitat types & landscapes
Livestock Rangelands	Drought control	Habitats	Traditional livelihoods	Ritual or spiritual connections
Medicinal Plants	Carbon Sequestration	Biodiversity	Culture & heritage	
Cropland	Soil formation & Maintenance		Prevention of irreversible change	
Fuelwood collection	Waste assimilation			
Construction Materials	Water purification			
Honey Production	Pest & Disease Control			
Coffee Production	Pollination			
Recreation	Storm protection			
Tourism	Shade			
Research	Wind shelter			
Education				

QUANTIFYING THE VALUE OF ECOSYSTEM GOODS AND SERVICES

Techniques used to measure TEV are highly dependent on the goods and services in question and vary in theoretical validity and acceptance, data requirements and ease of application. Some ecosystem goods and services are market goods with evident values, but where goods and services are not present in markets two broad approaches can be used to attribute value; revealed preference and stated preference methods. In addition to these methods, benefit transfer can be used to determine value from related studies (Figure 4). These methods are briefly described here and can be found in more detail in various handbooks and manuals (see e.g. IUCN, 1998; OECD, 2002; Pagiola *et al.*, 2005).

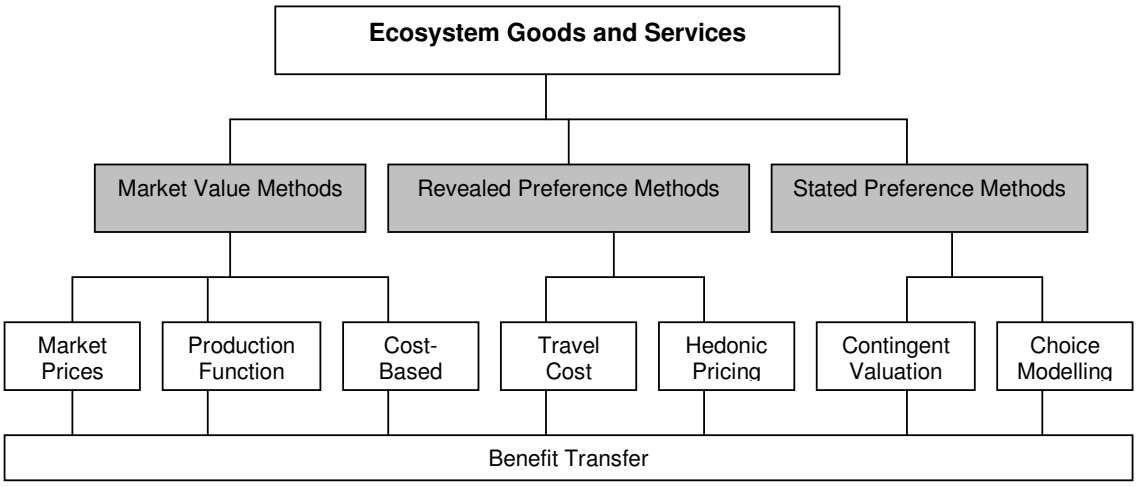

Figure 4. Environmental Valuation Methodologies
(adapted from OECD, 2002)

MARKET VALUE METHODS

There are three main valuation approaches that are based on market values, the observed market and related goods approach, the productivity approach and cost-based methods (OECD, 2002).

Where ecosystem goods and services are directly traded on markets, value can be observed through market prices. These market prices are usually the best estimate of WTP as they reflect decision-making reality (UNEP, 1998). Other non-market goods, such as the products arising from subsistence production, can be derived using the

market price of a similar good or the value of the next best alternative. These goods must be comparable, with a high degree of substitution between them. If they are perfect substitutes their economic value should correspond. The value of fuelwood collected for consumption with the home, for example, can be inferred through market prices of sold fuelwood, or alternatives such as charcoal or kerosine. Using market-prices methods we assume that the market is efficient. Where this is the case the market price is the equilibrium between demand and supply and marks the point where the consumer's WTP is equal to the costs of production. This means the price reflects the full opportunity cost of inputs such as transport, marketing, labour and processing costs of products (Bishop, 1999). The costs of these inputs need to be accounted for in order to extract the true value of a market good and in cases where markets are known to be imperfect and price distortions exist, they must be adjusted for. Corrections for market failures and inputs will make application of this method more complex, though overall the use of market values is a widely accepted method as WTP is directly measured.

The productivity approach traces actual changes in environmental quality to see how the value of marketed goods change. Ecosystem goods and services are thus viewed as production inputs. Using the dose-response relationship between a non-market benefit and a level of output of a marketed service to infer value requires in depth knowledge of the biophysical link. This often necessitates long-term data collection and models often contain a high level of uncertainty. However, this environmental production function model is useful in assessing the value of services and far reaching benefits such as hydrological services (see Acharya, 2000).

Cost-based methods estimate value through observation of behaviours taken to maintain a level of ecosystem goods and services through replacement costs, defensive expenditures, and opportunity costs. The replacement cost method estimates value as the cost of reproducing a commensurate level of benefits for lost goods or services. It is heavily criticised, as it is not known if individuals would actually incur these replacement costs or if human engineered systems could even provide identical solutions (Bockstael *et al.*, 2000). The costs of protective measures, or defensive expenditures, to maintain a level of an ecosystem good or service can be seemingly easy to calculate, however, market goods often have joint benefits or only partial success representing only a portion of the actual values held (OECD, 2006). Finally, the cost to secure goods and

services can be estimated through the opportunity cost approach that provides an estimate of the value of a conserved area based on forgone benefits of alternative uses. While these cost-based methods are fairly straightforward to apply they are not widely accepted, as the inferred value bears no direct relationship with WTP or the demand for a good or service (OECD, 2002).

Revealed Preference Methods

Revealed preference (RP) methods are used when market information and behaviours can be used to infer value of non-marketed goods and services. These methods use a surrogate market to imply value of embedded goods, and include travel cost methods (TCM) and hedonic pricing.

Travel cost methods use survey data on direct costs incurred to enjoy a benefit and are commonly used to estimate demand for recreation at specific locations (see Bhat *et al*, 1998; Day, 2002) where the value of the non-marketed good can be derived through appreciation of inputs of other marketed factors. A variation of the TCM can also be employed where labour is the main input and goods are non-marketed. This opportunity cost of labour approach, assumes the input of labour, for a rational individual, is a minimum estimate for benefit derived. It is useful to value goods harvested by rural communities without cash economies, but has limitations where labour opportunity costs are difficult to value adequately due to the lack of labour markets and seasonal changes in opportunities (Bishop, 1999).

Hedonic pricing methods correlate variations in the price of marketed goods to changes in levels of a related non-market good, for example impacts of noise pollution on property prices can infer an implicitly traded value for peace and quiet (Bateman *et al.*, 2004). Both hedonic pricing and TCM require large data sets to discern between influencing factors and statistical techniques to draw out values an as such they are less easy to apply to biological resources and are predominantly used in developed countries. Though not reliant on direct market values, RP techniques observe existing markets and so are found more acceptable to policy makers than stated preference (SP) methods using hypothetical markets to assess value.

STATED PREFERENCE METHODS

Stated preference methods are largely used to value non-use goods and services with no behavioural trail. WTP is elicited, through intended action, on a hypothetical market for a change in the level of provision of a good or service. These techniques are survey-based so are more labour intensive in their application. Two dominant survey methods exist, contingent valuation and choice modelling and despite strict procedural rules produced by the National Oceanic and Atmospheric Administration (NOAA) (Arrow *et al.*, 1993), still elicit debate on their theoretical validity and reliability (see Bateman *et al.* (2002) for a further discussion of SP methods).

BENEFITS TRANSFER

A further method of valuation is benefit transfer (BT), by which estimates from existing ecosystem valuations are adopted in new valuations. There are two main approaches identified by Splash (2006), namely function transfer and unit transfer. Function transfer involves the transfer of a set of variables that determine a value whereas unit transfer simply takes a value in one context and applies it to another. The appeal of this method is evident in time and resource savings in the absence of primary data collection, but the introduction of uncertainty calls the validity of BT into question. Borrowing values without considering the local context in the past has lead to erroneous results (see Brouwer, 2000; Christie *et al.*, 2004). For BT to be employed the primary study must be accurate, the study sites must be matched for environmental and institutional characteristics and temporal variations must be considered.

AGGREGATING THE VALUE OF ECOSYSTEMS

Welfare economics assumes that individuals' preferences can be aggregated to reveal the value to society as a whole[2]. As such, we must first decide the relevant 'society' over which to aggregate. Since the flow of goods and services span both geographical and political boundaries, determining the relevant stakeholders depends on which aspects of TEV are being considered. Direct-use values are likely to decay with increasing distance from the source (Bateman *et al.*, 2006), whereas indirect and non-use values may even

[2] It is noted that there are pitfalls in attempting to determine such a social welfare function, the discussion of which is beyond the scope of this report (see Arrow, 1950). Critics of the 'weak theoretical foundations' of welfare economics and its implications as a tool for evaluating environmental policies are explored further in Gowdy (2004).

increase from the source. Inferring preferences established at one scale and applying to another will, therefore, lead to significantly erroneous estimates of value. Thus, the applicability of valuation studies in the support of decision-making will be enhanced by the proper consideration of scale and standing of valuation studies (Hein *et al.*, 2006).

Where the relevant society over which to aggregate has been defined, the constituent values of the TEV framework may be aggregated to infer the total use value of an ecosystem (Pearce & Turner, 1990). Considered additive, this seemingly simple summation can be complicated by ecological complexity and where many valuation methodologies have been applied.

The provision of goods and services results from many interlinked natural systems and the linear aggregation of their values without proper consideration of this complexity can lead to double counting of benefits. An example, given in Hein *et al.* (2006) is the double counting of the indirect value of a pollinating service, and the consequential fruit direct value. Even where we can be certain of additivity of estimated values we must also ensure that the values have been expressed through a compatible common denominator and through comparable indicators (Hein *et al.*, 2006). The use of money as a metric allows consistency between units but the application of different valuation methodologies means that not all estimates are comparable. Some valuation techniques can measure a demand function and so include consumer surplus (the TCM, for example), while others measure the marginal WTP and so omit consumer surplus (such as market values). In consequence, the aggregation of values in order to find TEV of ecosystems is not straightforward. As such, there have been only a few attempts to estimate TEV on a large scale (see e.g. Adger, 1995; Rosales *et al.*, 2005; Croitoru, 2007) and some that have inaccurately have come under considerable critique; Costanza *et al.*, (1997) aggregated values over a global population and reported values in excess of global GDP.

ALTERNATIVES TO TOTAL ECONOMIC VALUATION

TEV is the dominant framework for ecosystem valuation studies and there is general agreement on the methodologies that can be applied, their strengths and their limitations. However, there are alternatives that can be employed in light of objections to the economic theory supporting TEV or, in the monetarisation of ecosystem goods

and services. Two main alternative approaches are Multi Criteria Analysis (MCA) and Participatory Environmental Valuation (PEV).

In MCA, stakeholders assign weightings to particular indicators that are not necessarily monetary. This incorporates the fact the difference stakeholder groups will have different perspectives on the importance of different types of value (Vermeulen & Koziell, 2002). It can therefore, accommodate social, environmental, technical, economic, and financial criteria and can be used in where a number of economically efficient alternative courses of action exist (CBD, 2007).

PEV is an emerging methodology where relevant stakeholders assess the relative impact of certain outcomes through deliberation to reach a broad consensus (Emerton, 1993). Though more qualitative than economic analysis, the relative impact of outcomes through PEV can be estimated in absolute terms where financially measurable costs or benefits are included in parameters to be valued (Hatfield & Davies, 2006). It is therefore, useful in valuing intangible costs and benefits and through implementation disseminates information, broadening the understanding of various stakeholders (CBD, 2007).

MEASURING DIRECT CONSUMPTIVE USE VALUE IN THE BME

Though many types of value arise under the TEV framework, this study will quantify only the direct consumptive use value provided to BME communities. The resultant aggregated value elicited by this study will provide an idea of the magnitude of the contribution that ecosystem goods and services make to the local economy and will highlight the economic value that will be eroded if the BME continues to be degraded. It should be noted that though not quantified, further categories of ecosystem value provided by the BME are not considered insignificant.

The population of relevant standing for this direct consumptive use value assessment can be clearly defined as those that permanently live within the fourteen woredas of the BME (Figure 5). This population derives direct consumptive use benefits from ecosystem goods and services in three key forms: crop growth, livestock production, and forest products (FP). The resultant products are commercially traded as well as consumed within households (HH). Therefore, they can be valued directly using market-value methods. The estimation of value of the key components of direct consumptive use values for a typical HH will allow us to calculate the annual value of the BME.

Figure 5. A Community of Relevant Standing, Rira

Since this valuation uses market prices, it is important to ensure that market imperfections are minimal or taken into account. In the BME HH sell home produce in unrestricted markets, there are no barriers to entry, and on market days many buyers and sellers converge to sell identical produce. This provides a highly competitive atmosphere where prices can confidently be assumed to be market driven. Furthermore, as a demand-led assessment, this study concentrates on the actual value realised by the communities. This is opposed to the potential flow of ecosystem goods and services, which, when valued through market prices, must take into account the increased supply of products that may result in price fluctuations. Thus we can be confident in the application of the observed market prices in the methodology.

DIRECT CONSUMPTIVE USE VALUE FROM CROP PRODUCTION

The demand for cropland has increased in line with the rising population of the Bale area. Crop cultivation is an important part of life in Bale with all HH members involved in distinct land plots or in home gardens through ploughing, weeding, harvesting, threshing and milling. Crop produce is primarily consumed within the HH with any excess and a few cash crops sold in local markets.

The BME provides water, sunlight, pollinators, and wind shelter for crop growth as well as being endowed with rich soils providing nutrients and regulating water flow. These inputs are necessary to product the finished crop product, as are human inputs of HH labour, seeds, equipment, and fertiliser. As land is state owned there are no capital costs associated with its use. The market equilibrium price includes these labour and capital inputs, so by assessing the difference between the total value of crop yield and the costs of inputs we can infer the value of the environmental input.

DIRECT CONSUMPTIVE USE VALUE FROM LIVESTOCK PRODUCTION

Livestock, believed to be the original subsistence system in Bale, are used for a variety of purposes including meat and milk products, manure, draught power, transport and skins. They are also important for social status, playing a role in marriage, dispute settlement and ritual performances (BMDC, 2003). This means they hold a variety of values dependent on the context in which they are used. In cropped areas, value will be derived from draught power and manure, in other areas livestock might be largely held for social functions such as savings and for capital accumulation, for transport to markets or for animal products such as meat, milk and skins.

HH are reliant on the environment to support the health and reproduction of their domestic livestock, particularly on access to commonly owned grazing areas and rivers. The private cost of livestock grazing in open access areas is zero and the benefits of livestock will accrue to owners each year until an animal declines in health and is either consumed by the HH, sold, or perishes through old age or predation by wildlife. Ideally, the valuation of livestock would be based on a substitute good for grazing fodder. However, without adequate data on the nutritional requirements of livestock varieties in

the BME a simple commercial approach is taken to make a conservative estimate the value of the environmental input. Only the sale of live animals will be considered here and thus sale of livestock products such as milk, and sources of value such as that for crop production and transport will not be considered. This will substantially underestimate the non-marketed value of livestock grazing through the bias to a single marketed product, but a lower bound estimate is considered better than none at all.

The market price of livestock includes the costs of production: HH labour, equipment, additional feed and medicine. As with crops, the land is state owned, and open-access, so there are no capital costs of land. By subtracting the costs of these human inputs from the value of the marketed outputs, we can calculate the value of the environmental inputs of livestock production.

DIRECT CONSUMPTIVE USE VALUE FROM FOREST PRODUCTS AND CONSTRUCTION MATERIALS

The FP harvested in the BME are varied, utilised in the construction of shelters and housing, collected for fuelwood, harvested and eaten, and used for medicinal purposes. This study therefore defines FP as the array of natural products that can be harvested from open-access natural areas. Whilst these goods are 'forest' by name, it includes those that are not explicitly found in forested areas.

FP are available for harvest as a result of the plant and animal diversity of the ecosystem and the services supporting them. The only human inputs required are HH labour. The value from the environment in this case will be the current market value of the FP gathered minus the costs of labour inputs.

Housing is constructed from FP and so construction materials are valued in a similar way. However, buildings will continue to provide benefits to a HH for a number of years. The value of these construction materials will therefore be considered separately to FP and estimated as the market price materials used over the number of years the resultant building will last.

STUDY DESIGN AND IMPLEMENTATION

Complementary qualitative and quantitative methodologies were employed in this study through Focus Groups (FG) and a structured HH questionnaire. These enabled a qualitative understanding of ecosystem uses and underlying motivations, aiding the interpretation of quantitative data, from where generalisations from the sample population could be scaled up over the BME.

Before data collection commenced time was spent in discussions with local people and staff of Frankfurt Zoological Society (FZS) and FARM-Africa/SOS-Sahel (SOS-FARM), two NGOs involved in the management of the BME resources. This allowed familiarisation with the communities in the area, a better understanding of day-to-day life in the BME and cultural sensitivities. For FG and HH questionnaires, well-qualified enumerators were employed from the Rural Development Office (RDO) in each kebele, or from the Woreda Development Office (WDO) (Appendix 1). They were selected for English language skills, to limit information loss in translation, and trained in the objectives of the survey, the application of the methodologies, and the recording of responses. On the occasion where the translator was not familiar with the kebele, a local liaison officer was employed to act as a guide to the interviewed community.

FOCUS GROUPS

Focus groups fall within Participatory Rural Appraisal (PRA) methodologies that allow research agendas to be molded by local opinion and concern (Milner-Gulland, *in press*). This commonly used qualitative research method brings together small groups of people for the discussion of a particular topic. It makes use of a non-threatening group environment to extract community perspectives on a topic that may not otherwise have the opportunity to surface, and may not have been predicted by the researcher.

FG began with an introduction to the study and specific FG topic. Two topics were investigated, General & Environmental and, Crop & Livestock Productivity. Checklists of issues and questions were prepared to guide the discussion for these topics (Appendix 2 and 3). In light of the fact that limitations of FG application arise where unrepresentative samples are chosen for discussions and where cultural sensitivities are not accounted for, this study made efforts to encompass different gender, age and

societal rank in groups, and the moderator was familiar with the local community and the regions cultures.

The objective of the General & Environment FG was to establish how the BME populace regards the natural areas where they live and what day-to-day issues they are faced with. The importance of determining local attitudes can help explain patterns of resource use as they often span differing levels of concern and depend on a range of individual beliefs and circumstances (Kotchen, 2000). The FG exploration of survey site customs and practices can then be related to ecological and demographic variables. It also established if there had been any notable changes in the environmental condition of the BME at each survey site in recallable history.

The objective of the Crop & Livestock Productivity FG was primarily to gather information on the type and magnitude of inputs required to generate crop and livestock outputs. This information is required for the direct consumptive use valuation and so minimised the time required of respondents to complete the HH questionnaire. This is an important consideration, as it is known that time allocation to livelihood generating activities can be delicately balanced (Bandyopadhyay *et al.*, 2006) and questionnaires that are too long result can in respondent fatigue and inaccurate responses. Inputs explored included HH labour time, access to markets for surplus produce and the wage rates through employment opportunities.

At each survey site three FG for each topic were conducted (see Figure 6). This allows for triangulation in order to validate responses, which is important for sources of socio-economic data that cannot be confirmed through direct observations. Discussions were conducted in Oromo or Amharic and the comments were translated into English before being recorded.

Figure 6. Focus Group, with Chiri Locals

HOUSEHOLD QUESTIONNAIRE

The HH questionnaire administered in this study was a structured interview with a sole respondent. The questionnaire allowed the collection of data in a formal standardised manner from a population too large to survey completely and was designed according to best practice guidelines (de Vaus, 2002). In order to select a sample population representative of the BME population, HH were chosen in a systematically random way. Every third HH was approached and if occupants are absent or unwilling to respond, the nearest neighbour was approached instead. This approach to reducing bias is logistically favourable than complete randomisation of HH, which would have required knowledge of number and identity of HH in the area prior to study commencement.

The content of HH questionnaires must consider the context in which they are asked. One-to-one questionnaire are not always appropriate for sensitive issues causing respondents to feel victimised or forcing them to respond erroneously. For the purpose of quantifying non-marketed goods in the BME this, largely closed, response format was appropriate and respondents were assured that any data collected would not be used for taxation purposes. The questionnaires were informal to make the respondent feel at ease, most commonly taking place outside a respondent's house. They were verbally administered so as to avoid problems with literacy and to ensure that the questions were understood. Care was taken to not introduce bias through relationship with the interviewee and the perception of their motivations.

Questionnaires were conducted in Oromo or Amharhic and responses were translated and recorded in a data book. Feedback was regularly provided to the translator at the end of interviews and where required.

A pre-pilot questionnaire was created and discussed in depth with SOS-FARM and FZS staff. Due to prevailing sensitive issues regarding boundary demarcation and changing user rights under new management plans in the BMNP, it was decided that specific mention of the park and conservation management plans for the area were avoided in HH questionnaires. Questions were revised for clarity and ease of understanding, checked for political and cultural sensitivities, and tailored to the dominant activities of survey sites.

Pilot questionnaires were conducted at the first survey location in order to test the appropriateness of the questionnaire and whether it achieved its objectives. Respondents were asked to answer questions as best they could as well as commenting on the content and time taken to complete. No recall problems were encountered in the pilot stage for annual HH productivity. Crops were largely single yielding per annum and enumerators were able to scale up where respondents recalled monthly or weekly amounts of FP. However, the questionnaire was amended to shorten the survey, to reword ambiguous questions and to reduce cognitive demands on both translator and respondent.

The final HH questionnaire was divided into five sections gathering data on attitude, use of ecosystem goods and services, and demographic characteristics (Appendix 4). Before each questionnaire began, an explanation of the identity of those involved, the study background and reasoning, and the estimated time of completion, was given. The preamble also made explicit what was implied by the term 'environment' and 'household' so that the results were consistent within, and between, survey sites. Environment was defined as '*the land around you, the plants that make up the forest, the animals within the forest, the air, the water and everything natural*'. A HH was defined as '*the people that normally eat and sleep under the same roof*', based on that defined by Rowland and Gatward (2003). Respondents were then given assurance of anonymity and the opportunity to opt out of participation. With permission, the questionnaire began with less intrusive questions to put the respondent at ease, before moving on to directly asking to recall quantities of goods produced and harvested over the course of a year and ending with HH demographics.

- The objective of part one was to reveal direct use values through respondents' behaviour and frequency of consumptive and non-consumptive activities. Values and beliefs were also elicited in agree/disagree statements to reveal attitude and an open-ended question explored environmental concerns. Revealing attitudes towards the contribution of these resources livelihoods is important as environmental attitudes are thought to derive from underlying values held by individuals (Kotchen, 2000).

- The objective of part two was to establish the crop and livestock productivity for each HH to contribute to the direct consumptive use value estimation. For crops total HH yield data was recorded, as well as the amount of surplus sold. For livestock, ownership numbers and information on the main inputs were gathered.
- The objective of part three was to determine the quantities of FP collected for HH consumption and sale, as well as sources of water, to contribute to the direct consumptive use value estimation. Information was gathered on who collects FP to build a more comprehensive picture of division of HH labour. Sources of water for crops, livestock and domestic uses were allowed examination of the input costs of water to inform the valuation.
- The objective of part four was to elicit the perceived value associated with different land uses. Respondents were asked to rank predominant land uses in the area according to the financial value that can be derived from these land types. The relative weight given to these land uses can be compared to the derived economic value established from parts two and three.
- The objective of part five was to collected demographic data on HH composition and materials used in the construction of the HH building. Demographic data is important in ascertaining the representativeness of the sample population and used in investigation of how demographic characteristics of the HH influences the attitude towards, use of, and direct consumptive use value derived from BME goods and services.

Data from HH questionnaires were first entered into EXCEL and then analysed using Intercooled STATA 8.0.

LITERATURE REVIEW

FUNCTIONS OF ENVIRONMENTAL VALUATION

The valuation of environmental services is a rapidly evolving and adapting area of research (Turner *et al.*, 2003). There has been a fast growing body of literature on the subject since the 1990s, and it is now an established approach to consider environmental systems as economic assets (Agudelo, 2001). The key characteristic of environmental valuation is that it is an economic analysis measuring both marketed and non-marketed values, and so differs from a financial analysis considering only the flow of money. A fundamental aim of the economic analysis is therefore to enable economically efficient decision-making. This economic efficiency is achieved when at least one person is made better off and nobody is made worse off by a change in resource availability, so-called Pareto efficiency. In reality, we are highly unlikely to achieve Pareto efficiency so an outcome is often considered economically efficient if those made better off could, in theory, compensate those made worse off, a so-called potential Pareto improvement. Despite this overarching efficiency aim, valuation studies conducted are highly context specific and are tailored to meet particular needs. The World Bank divides ecosystem valuations into four distinct areas that exemplify this; the value of the total flow of benefits, the net benefits of interventions, the distribution of costs and benefits and, identifying financing sources for conservation (Pagiola *et al.*, 2005):

- It is a widespread societal belief that the environment has 'value'. The determination of the total flow of benefits from ecosystems allows us to emphasise the scale of this 'value', or the contribution of ecosystem goods and services to human welfare. This type of investigation also allows for inclusion of this economic flow in a country's System of National Accounting (SNA), promoted in the quest to operationalise the concept of sustainable development (see UN, 1993) and also sustainable resource extraction (Hassan, 2002). By quantifying an ecosystem value, the profile of environmental concerns can be raised in both the public and political arena.
- Alternatively, environmental valuations of the net benefits that result from a project, policy or management change, allow the justification of spending on ecosystem conservation. The assessment can be of a specific intervention or a business-as-usual scenario. These both allow a comparison of increases in

human wellbeing (benefits) against reductions in social welfare (costs), in a common metric (money), of a given intervention (OCED, 2007). This cost benefit analysis (CBA) is an important tool facilitating more transparent decision-making.

- It is not only the aggregated ecosystem values that are useful. Despite economic efficiency of interventions instructed by environmental valuation, the distribution of benefits and costs can be asymmetric across stakeholders (OECD, 2006). The assessment of the equity over socio-demographic variables can aid the understanding of incentives driving resource use and can avoid imposing negative impacts on vulnerable groups of society (Pagiola *et al.*, 2005).
- Where environmental valuation can demonstrate a significant contribution of ecosystem goods and services to the economy there is potential for sustainable financing of conservation. This can be achieved firstly, through securing public resources after raising awareness of the scale of benefits, and secondly, through the establishment of markets for environmental services (MES) whereby the benefits are captured and their values realised in markets (Pearce, 2004).

These distinct areas are useful to appropriately frame a study and to ensure that relevant policy questions are addressed. In light of these different objectives, undertaking a full TEV is not always necessary. To undertake TEV would be costly, time consuming and difficult when the priority ought be ensuring that the values measured meet the research needs (IUCN, 1998). We therefore, find that environmental valuation literature is mostly focused on valuing a subset of the ecosystem goods and services in discrete locations. A review of ecosystem valuation literature relevant to the current study is presented below.

EXPERIENCES IN THE VALUATION OF CROP PRODUCTION

In developing countries crop production remains largely at subsistence levels making value assessments problematic without substantial fieldwork. The studies that have attempted to assess the value of crop productivity at this level are largely conducted in the context of rural livelihood analysis (Shackleton *et al.*, 2001). Through survey and questionnaire investigating both the outputs and inputs, a monetary value can be assigned to crop production. These rural studies have valued mixed cropping rather than larger-scale commercial valuation that is often focused on a single crop product. Dovie et al. (2003) valued both the marketed and non-marketed values of crop

production by HH in South Africa. Finding an annual HH value of US$ 443.4 and costs of production inputs incurred low, they suggest better accounting and resource availability investigation to make better policy and targeted rural support. With 8.8 million Ethiopians receiving some form of food assistance in 2005 (EIU, 2006), the assessment of crop value at a HH level rather than at the national accounting level, will enable the better targeting of relief and food security schemes in times of hardship such as that seen in 1984 and more recently in 2002/3.

EXPERIENCES IN THE VALUATION OF LIVESTOCK PRODUCTION

Pastoralism is thought to be routinely undervalued, leading to inappropriate policies promoting alternative production systems that are more damaging to ecosystems or economically inferior (Davies, 2007). Existing valuations are split between those that look at the values derived directly from the animals and those that value the land areas on which livestock forage. The attempts based on direct values are again divided between those looking at conventional commercial outputs, and those that encompass wider values. In general livestock valuations are often biased to a single marketed product or limited to particular use values (Arntzen, 1998), often dealing primarily with private values.

Valuation of livestock was initially focused on commercial products and large-scale livestock rearing. This was largely for financial and national accounting, and livestock value continues to be reported in government figures within agricultural contribution to GDP. Agriculture, including the livestock sector, accounted for 42% of GDP in Ethiopia (EIU, 2006). These commercial valuations are largely centred on a single marketed product, such as meat, that may well be less valuable than other products especially in subsistence production where sold produce is not the sole reason for keeping livestock. The numerous values of cattle include; home consumed meat, milk and skins, transport, draught power, manure, and employment opportunities, as well as less obvious benefits such as insurance, investment, risk management and socio-cultural values (Barrett, 1992). Marketed produce valuation will therefore assess only a proportion of livestock value. In Zimbabwe, Scoones (1990) found that 57% of value is derived from draught power, 22% from milk and 16% from transport, with manure, sale and slaughter combined accounting for only the remaining 5%. Similarly, Danckwerts (1957) cited in Barrett (1992) found that only 32% of the total gros value of cattle

production came from net sale of animals and ploughing accounted for 41%. This is exemplified by a considering a study by Dovie *et al.* (2006) that valued the multiple benefits of livestock production to rural households in South Africa at US$ 656 annually. This value excludes the value for cattle savings, but is still substantially more than the value of annual marketed off-take estimated by Nyariki (2004) in Davies (2006), of US$ 165 per HH in Kenya that drew on Government statistics and did not consider further use values.

Alternative approaches value the grazing lands of livestock rather than specific livestock outputs. The value of public land forage has been assessed through various methods including WTP for forage and grazing permits in developed countries (see Bartlett *et al.*, 2002). However, these studies are again largely involved with the private sector. Even where valuation is not commercial, complementary products of livestock production complicate valuation undertaken on grazing areas. Livestock grazing in Europe is vital to maintain the value wildlife conservation areas (EN, 2005), wild ungulates can be dependent on areas grazed by livestock (Frank, 1998), and grazed areas can provide opportunities for gathering of natural products. Furthermore, these benefits are not necessarily additive and grazing competition and predation by wildlife can reduce livestock returns.

Arntzen (1998), in a valuation of Botswana rangelands, estimates the direct use value of rangelands considering three components: livestock, wildlife utilisation, and gathering of natural products. Values were attributed through the market prices of products and substitutes. The market value of livestock sold and home slaughtered was established net of production and marketing costs. Draught power through substitution costs of tractor power. Manure through the assumption that crop yields will increase by 25% through application, and milk by replacement with long life milk. The per hectare value based on the size of the communal lands, was found to be extremely low at Botswana US$ 1.35 per hectare. Whilst this is thought to be an underestimate due to scarcity of statistics and reliance on average values, it does highlight the many sources of livestock value that people derive from animal based and forest based products arising through the presence of rangelands. Furthermore, it highlights the difference between private and social values that are often neglected in livestock valuations but arise as a result of common property resources and government subsidies.

The patterns of small livestock herds grazing on communal lands in the day and returning to homesteads at night are commonly found across Africa (Barrett, 1992). This livestock production is often considered by policy-makers to be a poor investment for development with low productivity, backward management, lack of market orientation and poor growth potential, and so outdated and economically irrational (Hatfield & Davies, 2006; Scoones & Wolmer, 2006). While it is clear that the exemption of all sources of benefits in valuation studies is likely to ignore substantial value, quantitative data for subsistence livestock production is hard to acquire and aggregate. There is therefore a great need to further develop livestock valuation methods to demonstrate whether livestock production systems can be essential assets to be used in development planning.

EXPERIENCES IN THE VALUATION OF FOREST PRODUCTS

Historically forests have been undervalued, with products other than commercial timber excluded from studies. The extractive values of commercial timber are much more easily applied to infer a forest value. This is particularly the case when forest products are not present in formal markets, where prices do not exist or quantities consumed are not known, and where forest products can be produced in conjunction with other goods and services making it difficult to avoid double-counting benefits. Since it has become recognised that the value of forest products can be substantial, particularly in rural settings (Vedeld, 2004), there have been many more efforts to quantify forest product benefits. Despite this growing number of studies, there still remains a lack of consensus on the definition of forest products, the valuation methodologies to be used, and the range of products studied.

Many studies have valued 'non-timber forest products' (NTFP), but the exact definition of the products included in this category appears elusive. Coined in de Beer and McDermott (1989) NTFP was proposed to include '*all biological materials other than timber extracted from forests for human use*', where forests were natural ecosystems so not only the products deriving from trees were considered. While some studies restrict the definition; Croitoru (2007) distinguishes between wood forest products, which include timber and firewood, and non-wood forest products that include fruits, grazing, and hunting; others expand it to include non-extractive goods such as ecosystem functions (Lampietti &

Dixon, 1995). This non-explicit definition has led to the creation of many more terms such as 'wild-products', 'natural products', 'non-timber forest and grassland products', 'veld products' and 'sustainably produced wood products' (see Belcher, 2003), leading to ambiguity and confusion that makes comparison difficult.

In addition to discrepancies in definition, studies have employed a range of valuation methodologies to assess the economic significance of NTFP. Where NTFP are not commercially available and cannot be valued through market prices, Delang (2006) suggests five valuation methods: assessing the opportunity costs of time to collect products, contingent valuation methods, PEV; substitute product values; and through exchange values where cash economies do not exist. The paper goes on to compare the opportunity cost of time approach with the substitute products approach in Thailand, finding a large discrepancy between methods. Through the valuation of labour time spent collecting NTFP households extracted US$ 31 whereas the use of substitute product methods estimated a value of US$ 303 annually. Without consistency across studies comparisons of value is problematical, though not necessarily prohibitive, between local policy contexts.

Some studies have attempted to review the comparative values of NTFP (Godoy & Lubowski, 1992; Lampietti & Dixon, 1995). These are largely concentrated on per hectare values of NTFP reporting values ranging from US$ 5 per hectare in the Brazilian Amazon to US$ 422 in the Peruvian Amazon. However, these valuations average benefits over entire forest areas and using potential rather than actual value. In reality a plot on the forest edge will have more value than an equivalent plot in the forest centre, with improved market access and reduced transport costs. Plus, where maximum sustainable yield is valued, if all potential NTFP were in reality brought to market, the value of these NTFP would fall substantially due to excess supply. Other studies have focused on specific NTFP, or on the actual household income derived from NTFP. These studies are often based on marketed or marketable products, to demonstrate that extraction and sale of NTFP can be significant sources of income (Neumann & Hirsch, 2000). A recent study conducted in Ethiopia estimates the combined marketed and non-marketed value of medicinal plants at just less than US$ 50,000,000 over the whole country (Mander *et al.*, 2006). These studies are important for demonstrating the benefits at regional scales and in assessments of potential for

commercialisation of NTFP, but less so for comparing the value of global forest areas. There are considerable differences in biodiversity, and so NTFP, between study sites as well in the physical ability, tools, skills and experience required to gather products that will impact on collection costs.

NTFP have been consistently promoted as a mechanism for poverty alleviation and conservation (Belcher, 2003), mainly as a result of their perceived importance in rural livelihoods. This widespread belief that the gathering of NTFP has fewer negative environmental impacts than timber selling and offers opportunities to diversify livelihoods needs to be more accurately assessed before it can be verified. Without consistency in NTFP definition or in the methods employed, NTFP valuations will continue to be more useful in demonstrating the scale of value rather than the actual value itself.

AGGREGATE VALUE OF KEY LIVELIHOOD COMPONENTS

Though not explicitly environmental valuations, studies have investigated the relative contribution of the various livelihood components to rural HH (Shackleton *et al.*, 2001; Vedeld, 2004; Dovie *et al.*, 2005). These assessments of HH incomes include the value from non-marketed home consumed produce. Where the land is a common property resource these values attributed to crops, livestock and forest products, net of input costs, can provide an idea of the environmental value.

The monetarisation and assessment of the relative contribution of agro-pastoralism and secondary woodland resources in rural South African HH was undertaken in Dovie *et al.* (2005). They found the annual income deriving from land-based income streams to be US$ 1660 per HH, and a positive correlation of this income with both the number of women in the HH, and the total number of people per HH. The income stream was broken down into US$ 443 from harvested crops (27%), US$ 656 from livestock (40%), and US$ 559 from secondary woodland resources including, fuelwood, grass, medicinal plants, construction materials and edible plants (34%). A similar study by Dercon (1998) provides a breakdown of the components of rural livelihoods in Tanzania. The income from crops (26%) is found to again be lower than that of livestock (53%), but higher than non-agricultural income (21%). While the relative contributions are similar to the findings in South Africa, the overall HH income is of a much lower magnitude of US$

203 and the exclusion of forest products in non-agricultural income makes further comparison with South Africa HH income difficult. A meta-study of 54 cases over 17 countries reveals a mean forest income of US$ 668 per HH, equivalent to 22% of HH income (Vedeld, 2004). In these studies agriculture, which included livestock, generated 37% (US$ 1123) of income and off-farm activities of 38%, comprising the three main income sources. However, this study also emphasised the significant ranges in income with results ranging from US$ 1.3 and US$ 3,460.

Often livelihood studies do not consider the labour costs of HH production that can be assessed through the opportunity costs of time using minimum wage rates. Shackleton *et al.* (2001) predicts that gros annual values presented in studies could decline 12% to 40% if labour costs are properly accounted for. Studies also rarely consider the complexity of interlinked crop and livestock products such as crop produce enhancing livestock reproduction, or livestock contributions to crop production such as draught power and manure.

The Tanzanian and South African studies demonstrate the heterogeneity in livelihood strategies found between countries, but there is also livelihood heterogeneity within communities. Dovie *et al.* (2005) recognise that comparable studies of the same region in South Africa have arrived at different estimates of relative contributions. As such, the comparison of HH income from the environment between different environmental and policy settings does not reveal much. Of greater contribution are the linkages between the HH income from key ecosystem goods and HH attributes such as, education, skills, and social status. These livelihood assessments can therefore compliment environmental valuation studies undertaken in rural areas where there are likely to be distributional impacts of management decisions, informing targeted development support on the basis of HH dynamics.

RESULTS

SURVEY SITE DEMOGRAPHICS

Four kebeles, in three woredas, were chosen as representative areas of the BME. Survey sites were concentrated around the BMNP and the towns of Dinsho, Robe and Goba, due to limited road access. They were selected, as far as possible, to represent different altitudinal zones and communities residing both within and outside the BMNP (Table 2, Figure 7). A systematic random sampling technique to select HH was attempted. However, implementation was problematic due to the dispersed nature of the communities and the spontaneity of questionnaires. HH heads were sought as respondents due to their envisaged accuracy of knowledge about the HH economy. A total of 195 HH questionnaires were completed between 23 April and 9 July 2007. Respondents were HH heads in 81% of questionnaires, which took a mean time of 44 ±1.5 minutes to complete (median=35).

Table 2. Survey Sites

	Kebele, Woreda	masl♦	Population†	Total Number of HH†	Number of HH Surveyed	% HH sampled
1	Chiri, Mena	1389	8368	1389	45	3.2
2	Rira, Goba	2902	1495	220	50	22.7
3	Fassil, Goba	2885	1578	255	50	19.6
4	Hora-Soba, Dinsho	3161	6056	760	50	6.6

♦ masl=metres above sea level

† Data from RDO Hora Soba (2007); RDO Fassil (2007); WDO Delo Mena (2007); WDO Goba (2007)

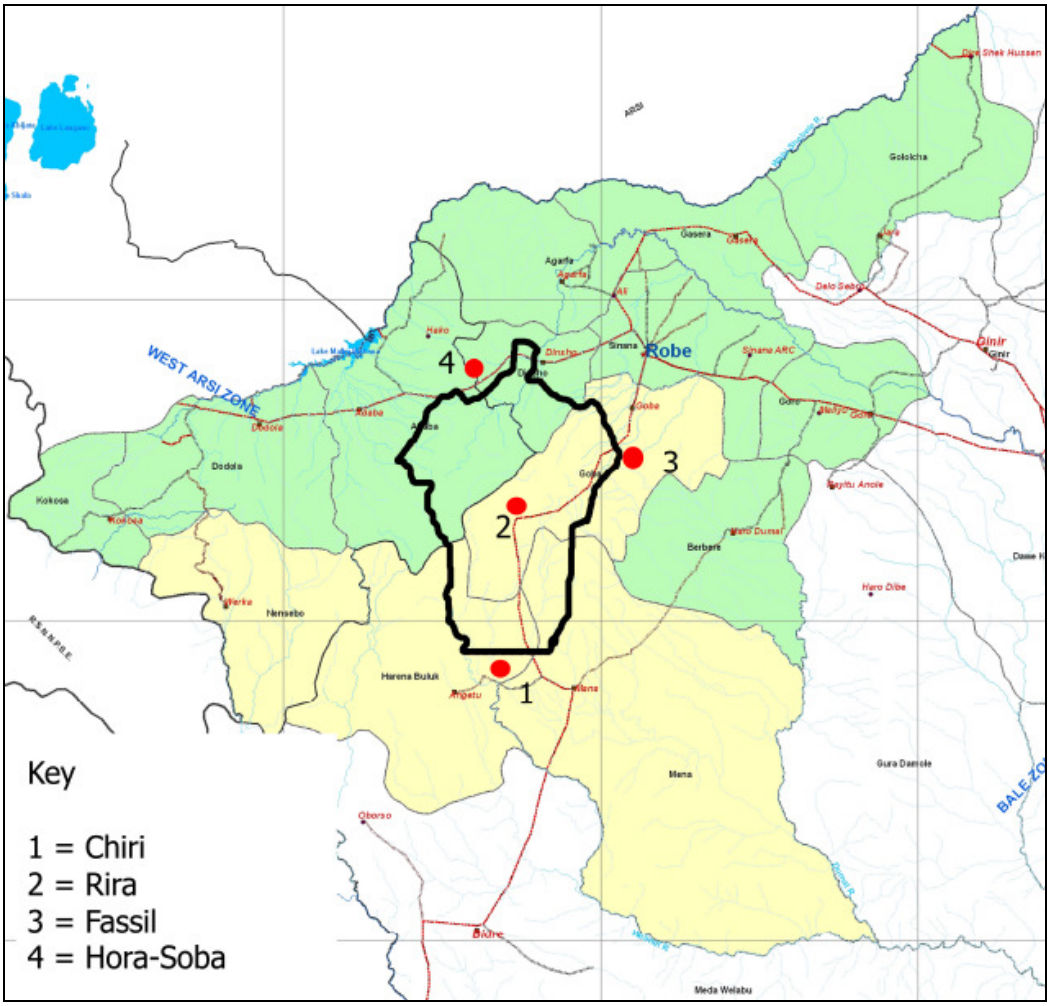

Figure 7. Map of the BME and Survey Sites

Ninety-seven percent of HH were Oromo by ethnicity, with Amharas found only in Fassil. The sample population (the total number of people reported as living within HH, summed over the four survey sites) was 48% female, 63% aged 18 or less, and over 50% with no formal education (Table 3). Mean number of people per HH was 7.38±0.25, with significant differences between survey locations ($F(3,191)=7.83$***[3]). Bonferroni analysis was used to conduct multiple comparisons after one-way ANOVA revealed significant differences between mean values. This multiple comparison test controls for the increasing chance of rejecting the equality-of-means hypothesis (Type I Error) if we were to conduct independent pairwise tests. To do this it crudely asserts that the adjusted critical level, a, is the true critical level, a, divided by the number of tests, n; or $a=a/n$. The analysis reveals mean people per HH in Chiri (9.51±0.65) is significantly

[3] 10%, 5%, 1% significance levels denoted as: *, **, *** respectively. Parametric statistics were employed for analyses due to the large size of the sample and to give statistical power.

higher than all other locations at the Bonferroni adjusted 1% level. No significant differences were found between other survey locations (Rira mean=6.64±0.30; Fassil mean=6.82±0.46; Hora Soba mean=6.78±0.50).

Table 3. Demographic Characteristics

Characteristic	Category	Proportion of Sample Population†	By Location			
			Chiri	Rira	Fassil	Hora Soba
Ethnicity	Oromo	0.98	1.00	1.00	0.89	1.00
	Amhara	0.02	1.00	0.00	0.11	0.00
Age Class	less than 11	0.38	0.41	0.42	0.28	0.39
	11 – 18	0.25	0.29	0.21	0.22	0.26
	over 18	0.38	0.30	0.37	0.50	0.35
Sex	Male	0.52	0.48	0.55	0.52	0.53
	Female	0.48	0.52	0.45	0.48	0.47
Education Level	None	0.51	0.64	0.52	0.33	0.53
	Grade 1-6	0.33	0.27	0.40	0.33	0.35
	Grade 7-10	0.15	0.08	0.08	0.31	0.12
	Grade 11-12	0.01	0.01	0.00	0.02	0.00
	Above Grade 12	0	0.00	0.00	0.00	0.00

† Sample Population is the total number of individuals reported by respondents as living within HH, summed over the four survey locations.

Agriculture was reported as the primary work activity of 84% of HH, overshadowing livestock management, bee-keeping, learning, and trade (Table 4). Livestock management was the most commonly reported secondary work activity (64%), followed by none, bee-keeping and agriculture (Table 5). Work activities appear specific to survey locations. In Chiri, 87% of HH reported no secondary work activity. In Rira bee-keeping was reported as both a primary (12%) and secondary (62%) work activities, and Fassil contained the only HH reporting firewood collection (14%).

Table 4. Primary Work Activity

Activity by Proportion	Agriculture	Livestock	Trade	Bee-Keeping	Collecting Firewood	Learning	None
Overall (n=195)	**0.84**	**0.10**	**0.01**	**0.04**	**0.00**	**0.02**	**0.00**
Chiri (n=45)	1.00	0.00	0.00	0.00	0.00	0.00	0.00
Rira (n=50)	0.50	0.28	0.02	0.12	0.00	0.08	0.00
Fassil (n=50)	0.90	0.08	0.00	0.02	0.00	0.00	0.00
Hora Soba (n=50)	0.98	0.02	0.00	0.00	0.00	0.00	0.00

Table 5. Secondary Work Activities

Activity by Proportion◊	Agriculture	Livestock	Trade	Bee-Keeping	Collecting Firewood	Learning	None
Overall (n=195)	**0.11**	**0.64**	**0.05**	**0.17**	**0.04**	**0.01**	**0.23**
Chiri (n=45)	0.00	0.09	0.04	0.00	0.00	0.00	0.87
Rira (n=50)	0.38	0.60	0.12	0.62	0.00	0.02	0.08
Fassil (n=50)	0.04	0.84	0.04	0.04	0.14	0.02	0.00
Hora Soba (n=50)	0.00	0.98	0.00	0.00	0.00	0.00	0.02

◊ Proportions sum to over 1 as respondents reported multiple secondary activities.

FG findings asserted the dominance of the agro-pastoral livelihood strategy and highlighted division of labour by gender. Male activities were more physically intensive (ploughing and harvesting), and female activities were focused around the homestead (cooking, breastfeeding, weeding, and collecting firewood and water). Activities of children were also local to the homestead specifically: weeding home gardens, guarding livestock and fetching water. The labour required for agricultural production was hard to discern with estimates of daily time spent working on crop production between 1 and 9 hours. Furthermore, some FG discussions reported paid agricultural labour as common while others reported reliance solely on HH labour. Where hired labour was reported, the wage rate was found to be between 5 and 30 ETB per day, or equated to a proportion of harvested produce. Similarly, the level of employed labour for managing livestock was not clear. The wage rate for tending livestock ranged from 0 ETB, where HH labour was used, up to 1000 ETB per annum (less than 3 ETB per day). In light of FG discussions highlighting the lack of job opportunities in the BME and gender division of labour it is likely that paid labour is scarce and principally available to men.

DIRECT CONSUMPTIVE USE COMPONENTS

The direct consumptive use value is calculated using data from the HH questionnaire, FG findings and a market-price survey. The market-price survey employed ten locals to record price information at the Goba Market; the most central and accessible market by all survey sites. Prices gathered were collated and averaged to obtain the current market value for the analysis. Market livestock and crop seeds vary in price according to whether they are 'local' or 'improved' (varieties with better breeding and so productivity). In all cases the 'local' variety prices were used to generate a conservative estimate. Where Goba market values were not available survey site local values or HH selling prices were substituted. HH who could not recall quantities for more than a

single crop yield, livestock ownership, FP or construction materials, were excluded from the component analyses. These four components are analysed separately then summed for each HH and aggregated across the BME.

The cost of HH labour input in production of crops, livestock and FP were assumed to be negligible, as there exist minimal alternative wage earning opportunities. Marketing costs of HH produce were also assumed to be insignificant, with HH either consuming products at home or selling locally.

CROP BENEFITS

Crops are grown by 96% of surveyed HH. Maize, tef[4] and fruits were dominant crops grown at lower altitudes, while barley and root crops dominated at higher altitude. Of 29 reported crop types, Chiri grew 19, while Rira, Fassil and Hora Soba grew 11, 10 and 9, crop types respectively (see Appendix 5 for crop type and price summary).

Seed costs, explored through FG, varied between 0.33 and 25 ETB for 1kg, depending on crop type. Overall, this seed input is low. Many HH collect seeds from previous years and fruit crops do not require seed inputs. Fertiliser use was absent or minimal due to lack of finance. The sparing use of manure as fertiliser was reported in Rira and Chiri, and the use of diammonium phosphate (DAP) only rarely on barley crops in Fassil. Animal manure is derived from HH livestock and DAP application (costing 4 ETB for 1kg), is highly uncommon. Equipment costs were minimal with livestock used for ploughing and farm tools made by HH from FP. Of 203 HH growing crops, 93% stated rain as the source of water. Irrigation schemes are not widespread due to high levels of precipitation. Only 17 HH (16 from Chiri) reported traditionally built irrigation schemes. As the level of inputs to secure the production of crops is minimal the direct consumptive use value deriving from crops is estimated as the market value of HH crop yield.

Of 185 useable HH, after data deficient HH and outliers were removed, mean crop value was found to be 10507 ± 658 ETB per annum (median=8109). The range of crop values were large from 0 to over 44,000 ETB and significant differences were found between study locations (Figure 8; $F(3,181)=7.78^{***}$). Bonferroni multiple comparison

[4] Tef is a robust cereal crop and a traditional staple of Ethiopian diet.

revealed that Fassil and Hora Soba had significantly higher value than Chiri at the 1% level, and Hora Soba had significantly higher crop value than Rira at the 5% level.

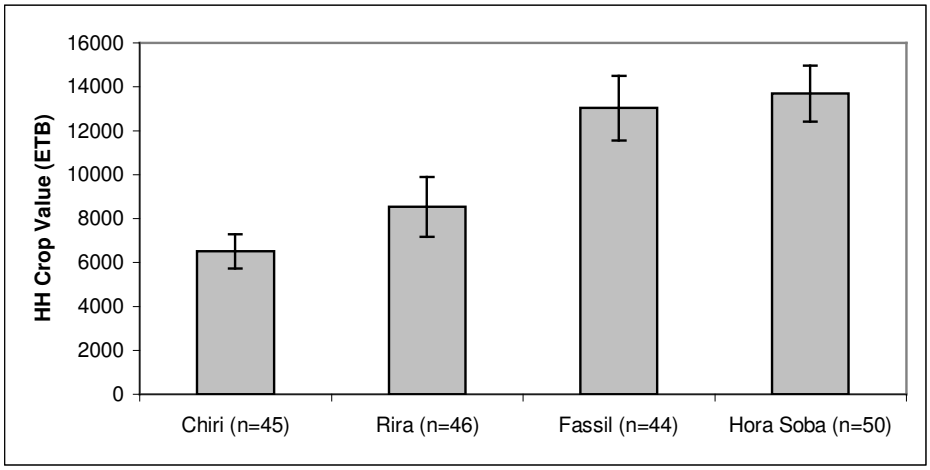

Figure 8. HH Crop Value per annum (ETB)

Of the overall HH crop value, on average, 45% was sold. While ANOVA indicated significant differences between survey locations at the 5% level ($F(3,167)=3.40^{**}$) and Bonferroni analysis revealed Chiri (45%) sold a significantly higher proportion Rira (38%) and Fassil (48%) a 10% significance level, with no significant difference with Hora Soba (52% sold).

LIVESTOCK BENEFITS

Livestock are kept by 99% of HH for both non-consumable (transport, ploughing and reproduction), and consumable purposes (milk, skins, selling and eating). No respondents reported social status, savings or insurance, as a reason to keep livestock. Livestock type and purpose was consistent between survey sites (see Appendix 6 for livestock type and price summary).

Livestock inputs, explored through FG and HH questionnaires. Medicinal costs were constrained to, at most, annual cattle vaccinations (0.30 ETB per animal), with the majority of ill livestock slaughtered instead of treated. Additional feed provision was reported in 81% of livestock owning HH, though this level of supplementation was much lower in Hora Soba (Table 6). While the proportion of HH providing livestock with additional feed is high, feed types are mostly products or by-products of HH

agricultural production. In FG discussions only oil-seed cake (2.20ETB per kg) and salt (0.8ETB per kg) were recalled as additional feeds. Therefore, this input is included in HH crop value or minimal due to low feed cost.

Table 6. Additional Feed to Livestock: Frequency and Type by location

	n◊	Additional Feed		Feed Type			
		Count 'yes'	Proportion 'yes'	hay/straw/grass	crop residue	salt	oilseed cake
Chiri	44	44	1	74	106	44	10
Rira	50	49	0.98	0	1	49	0
Fassil	50	49	0.98	1	1	48	27
Hora Soba	50	16	0.32	4	16	13	11
Overall	**194**	**158**	**0.81**	**79**	**124**	**154**	**48**

◊n=number of HH owning livestock

Water for livestock was sourced from rivers in all cases with less than 50% of HH accompanying livestock to water. Of these, 45% of HH sent children to accompany livestock. Distance to grazing land took a mean time of 1.35 ±0.06hours (n=288) and was not significantly different between survey sites ($F(3,384)=1.99$, $p=0.12$). Interpretation of this result is problematic as it is unclear whether grazing distances are travelled daily or seasonally. FG reported grazing lands between 0-72km from survey sites suggesting seasonal travel. As cost of HH labour was assumed negligible this did not have implications for the direct consumptive use value of livestock.

HH who could not recall accurate numbers of livestock and outliers were removed from the analysis. Overall the mean livestock value was 2065 ±148ETB (median=1668) ranging from 0 to 9020ETB with significant differences between study locations (Figure 9; $F(3,180)=2.45$*). Bonferroni analysis shows HH livestock value in Chiri was significantly lower than Rira at the 5% level.

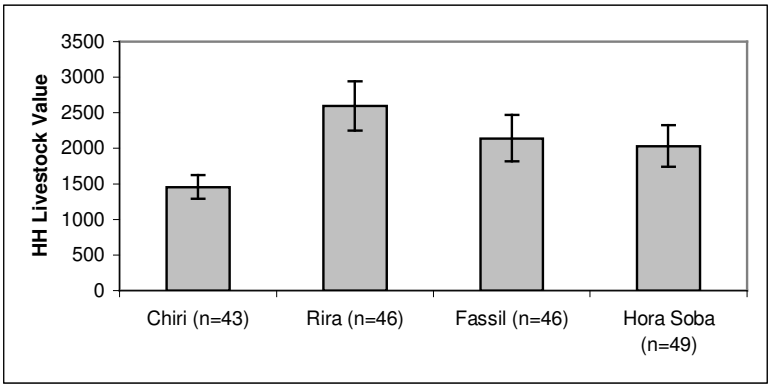

Figure 9. HH Livestock Value per annum (ETB)

It must be emphasised that this value is based on only live animals sold by HH and not on animal products. Animal products observed to be sold included milk products from cows, goats and sheep, eggs of chickens, and skins of goats, sheep and cows. This value, along with other non-consumptive values of transport and draught power are not valued here.

FOREST PRODUCT BENEFITS

The gathering of FP was reported in all surveyed HH. Collected by men in the majority of HH (63%, n=783), firewood was gathered predominantly by women and children (74%, n=192). Time to FP sources had a mean of one hour 45 minutes, or 3.75km, with significant differences between survey sites ($F(3,759)=7.2^{***}$) with FP sources in Hora Soba significantly further than all other survey sites at the 5% level. There are also significant differences between FP ($F(7,755)=30.23^{***}$). Bamboo sources were further from HH than all FP but honey and wood. Honey, in turn, was significantly further from all remaining FP. Medicinal plants were significantly closer to HH than all other FP (Table 7).

Table 7. Multi-comparison of Mean Time to Forest Products

	Bamboo	Climber	Fence	Firewood	Grass	Honey	Medicinal Plants
Climber	-1.338***						
Fence	-1.815***	-0.477					
Firewood	-1.830***	-0.492*	-0.015				
Grass	-1.563***	-0.225	0.252	0.267			
Honey	-0.102	1.236***	1.713***	1.728***	1.460***		
Medicinal Plants	-2.499***	-1.161***	-0.684**	-0.669**	-0.936***	-2.396***	
Wood	-1.470	-0.131	0.345	0.360	0.093	-1.367	1.029

No data exists for Forest Coffee, reported as a crop in HH questionnaires. Figures show the Row mean - Column Mean with Bonferroni adjusted significance levels.

As the input to secure FP is HH labour, assumed to be negligible, direct consumptive use value equates to the market value of FP. A single outlier was removed to find the overall mean value of FP of 3696 ±221 ETB (median=2680), ranging from 0 to 14,243 ETB with significant differences between study locations (Figure 10; $F(3,190)=94.50^{***}$). Bonferroni analysis shows Chiri has significantly higher value than all other survey sites at the 1% level, and Hora Soba has significantly less than Rira and Fassil at the 1% and 5% level respectively. The magnitude of value from specific FP varies between sites (Figure 11). Chiri is the only survey location where forest coffee grows and here it provides a mean value of over 5000 ETB per HH. Scaling up over all Chiri HH, this equates to over 7,500,00 ETB per annum. In Rira, honey production is worth on average 1403 ETB per HH, or over 300,000 ETB per annum for all Rira HH. Despite difference in value, there are similarities in FP types (see Appendix 7 for summary of FP). Over all survey sites firewood was the most frequently reported FP with a mean annual value of just under 1500 ETB per HH.

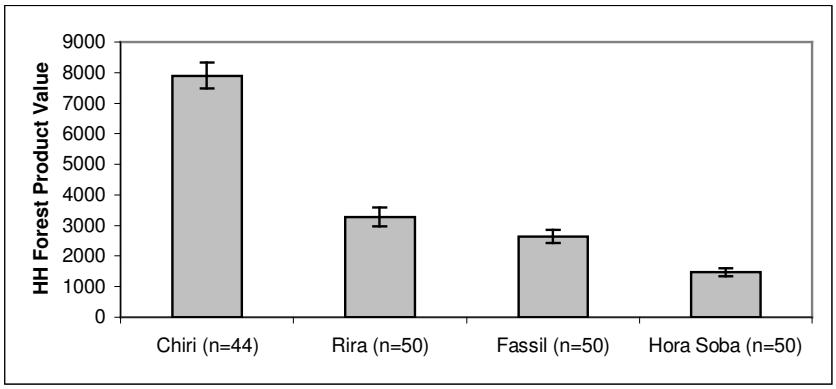

Figure 10. HH Forest Product Value per annum (ETB)

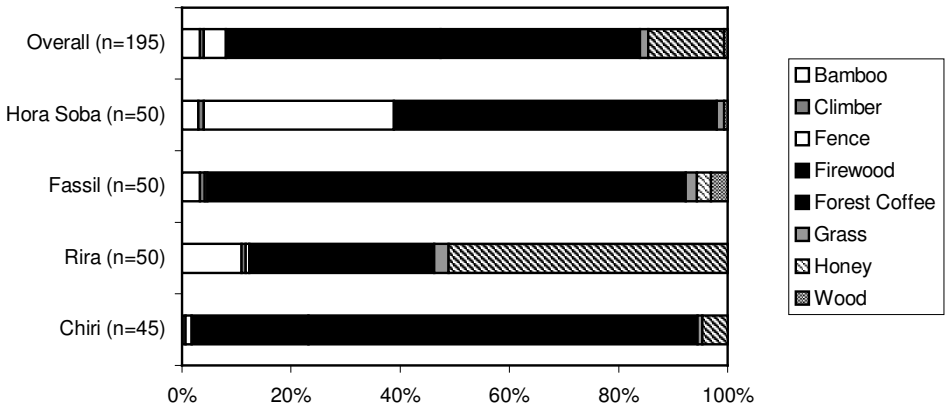

Figure 11. Forest Products Value by Location

Of the 193 HH that colllect FP, the mean proportion sold is 0.38 ±0.05. However there are significant underlying differences between the locations ($F(3,189)=7.39^{***}$). Multiple comparison reveals Hora Soba sells significantly less than Chiri and Fassil at the 1% level, and Rira at the 10% level. Over 50% of Chiri FP value is derived from forest coffee, which accounts for 97% of FP sold. In Rira 43% of FP value comes from honey, accounting for almost 100% of FP sold, and in Fassil, 55% of FP value comes from firewood accounting for 94% of FP sold. Hora Soba sells less than 2% of forest product value.

Construction Material Benefits

Housing in Bale is simple in structure and visually consistent throughout rural areas. A circular of wooden structure is tied with climber, covered with soil and straw on walls and a roof made with grass (Figure 12). Maintenance materials for roof and walls are included in the valuation of FP and as before the costs of HH labour are negligible.

Figure 12. Exemplary House Structure in the BME

The mean value of HH construction materials was 1255 ±49.4ETB, (median=1112) lasting for a median of 15 years. The median estimate was used to reduce sensitivity to outlying longevity estimates. The value of HH construction materials are not significantly different between survey sites (Figure 13; $F(3,171)=1.00$, $p=0.39$), supporting the observation that HH across BME conform to the same design.

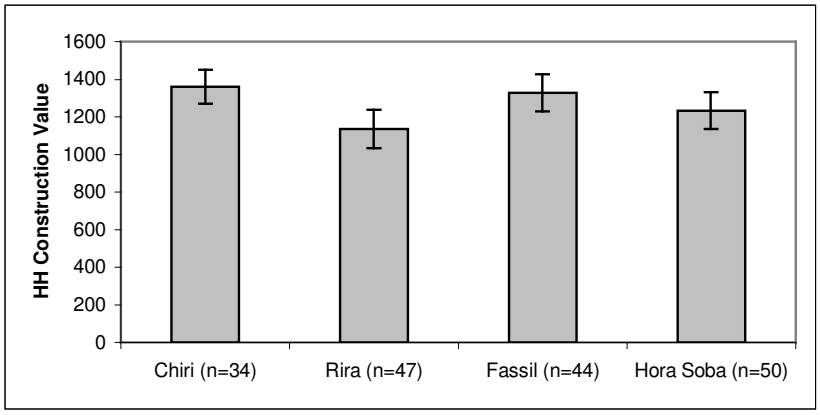

Figure 13. HH Construction Material value by location (ETB)

WATER

Water for domestic uses (cooking, cleaning, washing) is a further direct consumptive use value provided to BME residents. As bottled water is not an appropriate market substitute and costs of labour have been assumed to be zero, this study qualitatively reviews its magnitude.

Domestic water is collected by women and children in 89% of HH and mainly sourced from rivers (89%). Across survey sites water reliability was reported as *all year plentiful* in 78% of HH (n=194), though 56% of Hora Soba HH reported water to be *seasonal plentiful* (n=50). Post-collection, 48% of HH filtered water through material or cloth before drinking or cooking to remove sediment. The mean time to source was 23 ±0.02 and 25 ±0.02 minutes (approaching 2km) in wet and dry seasons respectively (median=19.8 in both wet and dry season), with significant differences in distance to domestic water sources between survey sites ($F(3,199)^5=12.34$***). While this does not affect this valuation it may have implications for future resource management.

TOTAL ANNUAL HH DIRECT CONSUMPTIVE USE VALUE

To quantify the per annum direct consumptive use value for each HH the value of crops, livestock, FP and construction materials were summed. HH with missing values for any of the four components were excluded from the analysis. The mean per annum value across the survey sites was found to be 16,540 ±770 ETB (n=160), with a median of 14,443 ETB.

[5] n=203 and is larger than the number of HH surveyed as HH reported multiple domestic water sources.

Of note is the non-significance of differences in the mean HH value between survey sites ($F(3,156)=0.93$, $p=0.43$) despite differences between component values (Table 8, Figure 14).

Table 8. Composition of Annual HH Direct Consumptive Use Value (ETB)

Location	n	Proportion of HH Value				HH DCU† Value (ETB)
		Crops	Livestock	FP	Construction Materials	
Overall	**160**	**0.65**	**0.13**	**0.21**	**0.00**	**16539.67**
Chiri	33	0.38	0.11	0.51	0.01	15262.14
Rira	40	0.59	0.18	0.22	0.01	15067.2
Fassil	38	0.72	0.13	0.15	0.00	18054.36
Hora Soba	49	0.79	0.12	0.08	0.00	17427.42

†Direct Consumptive Use (DCU)

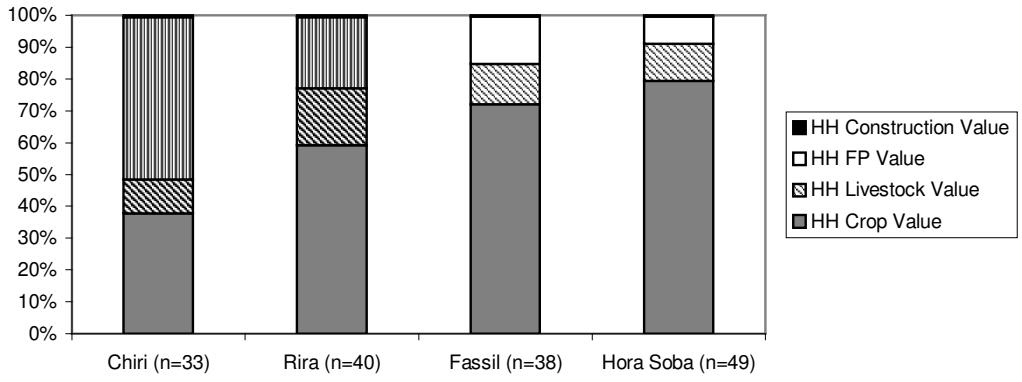

Figure 14. Composition of Direct Consumptive Use Value

In order to assess the theoretical validity of the direct consumptive value of the HH a simple ordinary least squares (OLS) regression model was designed. OLS regression is based on a linear relationship between the independent and dependent variables, with the coefficient obtained by the minimisation of the sum of the squared error terms. It assumes a homogeneous influence of the independent variables, and therefore assesses the dependent variable mean. In this model the direct consumptive use value is the dependent variable and independent variables are those that might explain HH value as follows:

$$\text{HH Value} = a_0 + a_1X_{1i} + a_2X_{2i} + \ldots\ldots a_nX_{ni}$$

Where:

a_0 = *y intercept,* $a_{(1,2....n)}$ = *coefficients,* $X_{(1i, 2i.....ni)}$ = *independent variables*

The explanatory variables included in the regression model are found in Table 9. Where explanatory variables were qualitative they were coded as dummy variables so as to allow quantitative statistical analysis.

Table 9. Independent Variables in HH Value Regression Analysis

Variable Code	Description	Code
chiri	Survey site 1, Chiri	dummy (1=yes, 0=no)
rira	Survey site 2, Rira	dummy (1=yes, 0=no)
fassil	Survey site 3, Fassil	dummy (1=yes, 0=no)
hora_soba	Survey site 4, Hora Soba	dummy (1=yes, 0=no)
people_HH	Number of people reported to be residing in the HH	value (people)
children	Number of HH residents less than 10 years of age	value (people)
young_adults	Number of HH residents between 11 and 18 years of age	value (people)
adults	Number of HH residents over the age of 18	value (people)
males	Number of HH residents that are male	value (people)
noedu	Number of HH residents with NO education	value (people)

In light of the correlation, and so non-dependence, of the number of people in the HH and number of people in age categories this was regressed separately. No significant relationships were found between the age structure of the HH and the direct consumptive use value ($OLS_{under10}$=371.55, p=0.38; $OLS_{11\text{-}18}$=743.21, p=0.14; OLS_{over18}=546.27, p=0.39).

Regression analysis found the direct consumptive use value is positively correlated with the total number of people residing in the HH (OLS=1402.80***) and negatively correlated with the number of non-educated people (OLS= -852.22*). The number of males residing in the HH were non-significant (OLS_{males}, -455.50, p=0.527), as were the location dummy variables (OLS_{Chiri} = -3075.25, p=0.25; OLS_{Rira} = -1868.63, p=0.40; $OLS_{Hora\ Soba}$ = 396.83, p=0.85). The independent variables of the model, however, only explain 10% of the variation in the HH value (R^2= 0.0973, F statistic= 2.71).

Post survey it was noted that an unknown proportion of the respondents were polygamous. The polygamy or monogamy of respondents was not requested in the HH questionnaire and, as such, it was unknown if the crop, livestock and FP productivity reported, or the number of people, was for a single HH or for multiple HH. In order to assess the accuracy of the direct consumptive use estimates per HH, population data from woreda and rural development offices were obtained. Using the average number of people reported per HH and the population data, a predicted number of HH was created. In two of our survey locations the predicted number of HH matched the reported values (Rira and Fassil) within 10%. However, in Chiri our estimate is 37% lower than the actual number of HH and in Hora Soba it is 18% greater than the actual number of HH (Table 10).

Table 10. Estimates of the scale of Polygamy in the BME

Location	Sourced Data•		Survey Data				
	Reported Population	Reported number of HH	Mean Number of People per HH	Predicted number of HH	% change from actual	+/-	Probable Cause
Chiri	8368	1389	9.51	880	36.66	-	Reporting HH members over multiple HH and productivity for both
Rira	1495	220	6.64	225	2.34	+	Minimal polygamy
Fassil	1578	255	6.82	231	9.26	-	Minimal polygamy
Hora Soba	6056	760	6.78	893	17.53	+	Reporting HH members for a single HH but productivity for both

• Data sourced from Woreda and Kebele Rural Development Offices

In Chiri, it is possible that polygamous respondents reported the number of people in both of their HH. This would lead to an over estimate of average number of people per HH. If they also reported the productivity of both HH, the HH direct consumptive use value would decrease by 4094 ETB (-27%). In Hora Soba, it is possible that polygamous respondents reported crop yields for both homes but the number of people in a single home. If this is the case and they share crop yield between the HH, the HH direct consumptive use value would increase by 3703 ETB or (+21%). It is also possible that the population data obtained from woreda and rural development offices is not reliable.

AGGREGATED BME DIRECT CONSUMPTIVE USE VALUE

Converting the HH value to US Dollars (US$)[6] and using data on the number of people per HH, we find a mean annual direct consumptive use value of **US$ 296 ±17.45** per person. No adult equivalent adjustments were made as HH survey did not determine the proportion of value falling to HH members. This gives a daily direct consumptive use value of **US$ 0.81 ±0.05** per person. Significant differences were found in the per capita direct consumptive use value between survey sites ($F(3,156)=5.25^{***}$)(Table 11). Multiple comparisons show that the larger Chiri HH had lower daily values at the 1% level, than both Fassil and Hora Soba (no other significant differences were found between survey sites). While this per capita value is below the UN extreme poverty level of US$ 1 a day (UN, 2007), poverty has a number of dimensions including assets and vulnerability that are not assessed here so it cannot be assumed that BME communities live in poverty.

Table 11. Direct Consumptive Use Value per capita (US$)

Location	Mean Annual DCU†		Mean Daily DCU
	per HH	per person	per person
BME	**1822.65**	**295.80**	**0.81**
Chiri	1681.87	186.03	0.51
Rira	1660.39	264.87	0.73
Fassil	1989.57	344.68	0.94
Hora Soba	1920.48	357.08	0.98

†Direct Consumptive Use (DCU)

The Arsi-Bale Rural Development Project reported the population of the fourteen BME woredas as 1,276,062 in 2001 (ABRDP, 2004). Using the IMF population growth rate of 2.76% between 2001/2-2005/6 (IMF, 2007), and adjusting for the fact that 15% of the population is urban, for which assumptions about the use of ecosystem goods and services cannot be made, this estimates a rural population of 1,277,131 at the start of 2007. While BME HH rely on components of direct consumptive use value according to site specific resource endownments, the finding that mean HH value does not vary significantly between survey sites allows us to confidently aggregate per capita direct consumptive use value across the BME.

[6] A rate of 9.0745 ETB to 1 US$ was calculated using the mid-price of interbank bid and ask prices on the 20 June 2007, the date of the market price survey (bid and ask prices sourced from: www.oanda.com).

The direct consumptive use value for ecosystem goods and services across the BME population is estimated at **US$ 377,777,500** per annum, a substantial contribution to the local economy.

ATTITUDES AND PERCEPTIONS OF THE ENVIRONMENT

ACTIVITIES

Questionnaire respondents were asked to report the frequency of various consumptive and non-consumptive, direct-use activities undertaken by HH members. These activities were defined in the pre-pilot phase and were recorded on a scale ranging from 1 to 5, where 1 was *not at all* and 5 was *everyday* (Figure 15).

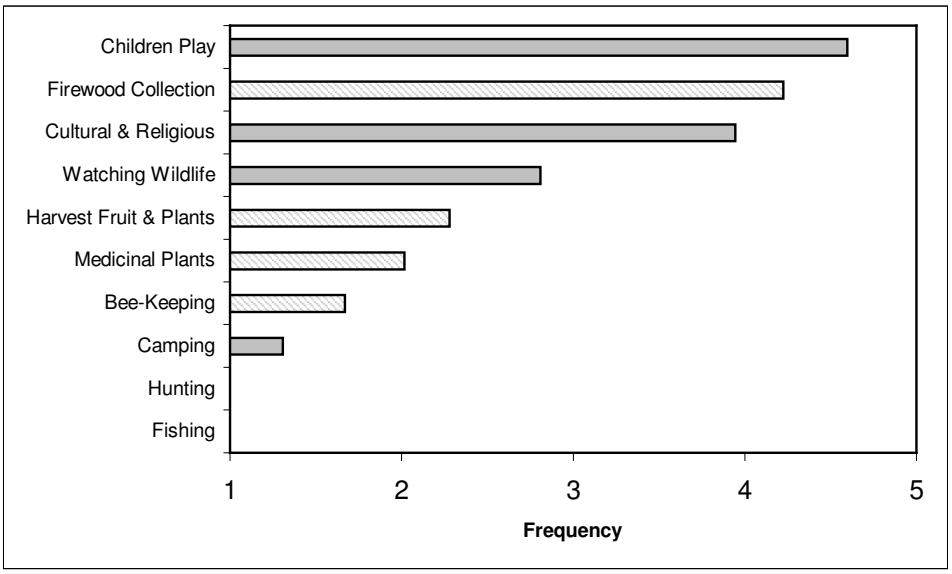

Figure 15. Mean frequencies of direct use activities
(1=not at all, 2=at least once a year, 3=at least once a month, 4=at least once a week, 5=everyday), solid shading indicates non-consumptive activities.

Of consumptive activities, firewood was collected at a mean frequency of *at least once a week*, corresponding with the quantitative information in HH questionnaires. Medicinal and edible fruits and plants were on average collected *at least once a year* but not more than once a month. Interestingly no respondents engaged in fishing or hunting of wild animals. This finding is supported by the lack of wild meat in local markets and no observations of hunters, traps or hunting equipment.

Of non-consumptive activities children playing outdoors was most frequently reported by HH, with *outdoor cultural and religious* activities taking place, on average, just less than once a week. It was expected that HH do not engage in *camping for fun* but was included to ensure that respondents were adequately considering their responses; results were infrequent as predicted.

Respondents were then asked to rate the contribution of activities to their wellbeing, defined as '*benefits to you in terms of generation of food, money and a general feeling of health and happiness*'. Ratings were made on a scale of 1-5 where 5 is very important and 1 is not important at all (Figure 16). This scale was reversed in the questionnaire to ensure that responses were not merely repeated from the previous question. Hora Soba was excluded from the analyses as the response logic between frequency of activities and ratings was not consistent. For example, hunting and fishing were conducted 'not at all' and rated as 'very important'. This is likely to amount to translator error in recording the responses in this survey location.

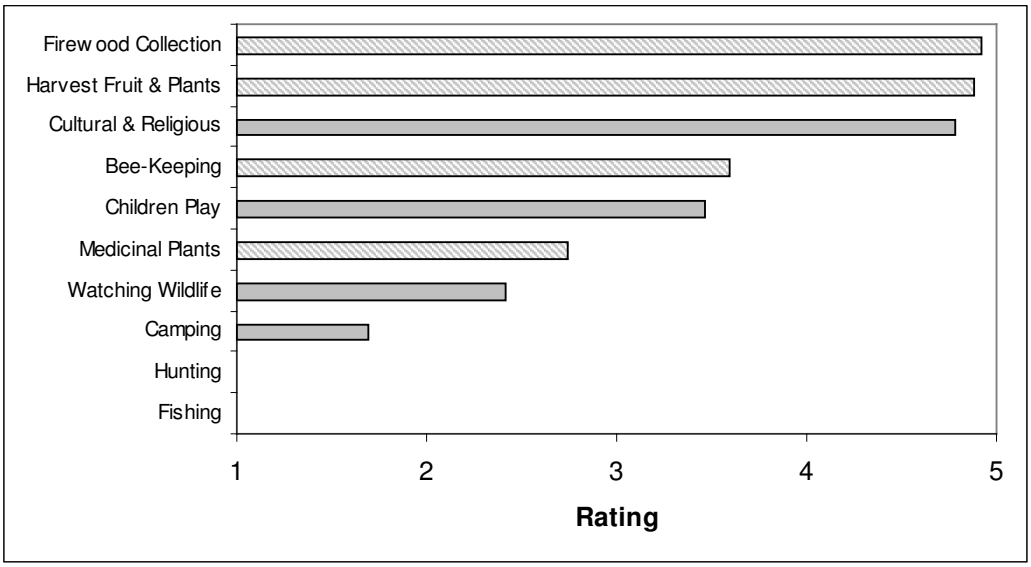

Figure 16. Mean rating of direct use activities
(1=not important, 5=very important), solid shading indicates non-consumptive activities.

The rating of direct use activities shows that consumptive activities are believed more important for wellbeing. Firewood and fruit and plant harvesting are above outdoor social activities. However, the frequency and high ratings attributed to non-consumptive

activities, especially outdoor cultural and religious activities suggest the magnitude of non-consumptive direct-use value could be considerable.

STATEMENTS

Respondents were asked to respond to agree/disagree statements on a three-point scale, to determine underlying motivations toward natural resource use and value types held (Table 12). While there seemed to be a general consensus about some statements (a), (b), (c), (d), (e) and (f), other statements (g) and (h), elicited responses that are more evenly distributed between categories. There was an overall rejection of anthropocentric or selfish motivations to natural resource use, and respondents commonly held option and bequest values. There was also a consensus that government should spend more money conserving the area, however, whether this statement truly represented indirect value is questionable as invoking the government as the source of financial investment may have resulted in ulterior underlying motivations. Trade-offs between the costs of conservation and the benefits of unlimited resource use, represented by statement (g), and putting natural resource use into a more general context, statement (h), were not so unanimously responded to.

Interestingly, while 79% of the surveyed population holds existence value stating that loss of plants and species due to loss of natural areas is a serious problem. Of the remaining population who either '*don't know*' or '*disagree*', 51% of responses arise from Rira, the only village completely contained within the national park. Furthermore, Chiri HH all disagree with statement (d) suggesting that they do not hold option value, perhaps because they cannot afford to forgo benefits now. Other small differences in responses between survey sites might arise from variations in local management, education, but equally may be due to enumerator differences as these were the most demanding on their translation skills (Table 13).

In the pilot stage of the HH questionnaire the responses options were reduced to a three point rather than a five point scale due to lack of understanding the distinction between *strongly agree/disagree* and *agree/disagree*. Furthermore, as *neither agree nor disagree* was not easily understood *don't know* was assumed as the mid-point. Despite the reduction in the scale of motivation strength, it was possible to perform simple

correlation analysis (Table 14). Though relationships are not particularly strong a number of points of interest arise.

- A significant positive relationship between selfish and anthropocentric motivations exists. As expected, these are both positively correlated with the trade-off statement, suggesting grouping of people with more human centred values.
- The anthropocentric use motivation has a significantly negative correlation with bequest value, which itself is positively correlated with existence value, further suggesting that non-use values are not held alongside the more human centred ones.
- Perhaps demonstrating the conflict between the subsistence strategies and conservation is the positive correlation between existence and general context and, option and trade offs. Respondents agree that the loss of diversity is a problem and wish that would like to be able to use resources in the future, yet they also have more important worries that they must trade off with natural resource quality or the costs of forgone benefits will be too high to subsist.
- This immediate subsistence motivation is supported by the significant negative correlation between the general context motivation and the option value. Where there are more important things to worry about they would rather use resources now and forgo the option of use at a later stage.

On the whole the attitude of BME communities appear pro-environmental. The statement responses show they also hold values that not quantified here including indirect, option and non-use values. Despite this positive attitude to natural resource use these communities appear to be motivated by more immediate HH needs that affect the choices HH make in resource use.

Table 12. Statement Response Frequencies and Descriptive Statistics

Statement		A	DK	D
(a) *anthropocentric*	If no one uses a natural area it does not matter whether it has lost its forest or not.	10	4	181
(b) *selfish*	If a natural area that **I** do not use loses its forest, I am not concerned that others will not be able to use it.	10	5	180
(c) *indirect*	It is worth the Ethiopian government spending more money to look after natural areas as they are as it attracts new business to the area.	171	6	18
(d) *option*	Even if I don't use some natural resources now **I** would still like them to be available in case I want to use them in future, even if that means I have to forgo some benefits of natural resources now.	145	4	46
(e) *bequest*	People have a responsibility to protect forests and natural areas for our children and our children's children, even if that means we have to forgo some benefits of natural resources now.	189	3	3
(f) *existence*	The fact that some animal and plant species may disappear from the Bale Mountains and Ethiopia due to loss of the natural areas is a serious problem.	154	6	35
(g) *trade-off*	The quality of natural areas should be maintained only if the costs to people are not very high.	97	7	91
(h) *general context*	People have more important things to worry about than the quality of the natural resources.	97	13	85

A = agree, DK = don't know, D = disagree

Table 13. Statement Response Frequency by location

Statement	(a) *anthropocentric*			(b) *selfish*			(c) *indirect*			(d) *option*			(e) *bequest*			(f) *existence*			(g) *trade-off*			(h) *general context*		
	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D	A	DK	D
OVERALL	**10**	**4**	**181**	**10**	**5**	**180**	**171**	**6**	**18**	**145**	**4**	**46**	**189**	**3**	**3**	**154**	**6**	**35**	**97**	**7**	**91**	**97**	**13**	**85**
Chiri	0	0	45	0	0	45	45	0	0	0	0	45	45	0	0	45	0	0	0	0	45	39	0	6
Rira	0	1	49	2	1	47	42	1	7	50	0	0	50	0	0	29	0	21	32	1	17	8	1	41
Fassil	1	0	49	1	0	49	42	3	5	50	0	0	49	0	1	42	0	8	20	1	29	11	2	37
Hora Soba	9	3	38	7	4	39	42	2	6	45	4	1	45	3	2	38	6	6	45	5	0	39	10	1

A = agree, DK = don't know, D = disagree

Table 14. Pairwise Correlation between statements

Statement	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
(a) anthropocentric	1							
(b) selfish	0.3603***	1						
(c) indirect	-0.0908	-0.1046	1					
(d) option	0.1291*	0.1214*	-0.1794**	1				
(e) bequest	-0.3634***	-0.1153	0.0019	-0.0978	1			
(f) existence	-0.0383	-0.104	0.0963	-0.2298***	0.2304***	1		
(g) trade-off	0.1738**	0.2058***	-0.0941	0.5471***	-0.052	-0.133*	1	
(h) general context	0.122*	0.1317*	0.0231	-0.4138***	-0.0281	0.2456***	0.0197	1

ENVIRONMENTAL CONCERNS

Of 145 HH, 77% reported that they had concerns about the state of their current environment. There was some variation between survey sites with a lower incidence of worries in Rira (36%), contained entirely within the park boundary. Some respondents included lack of education, jobs and money in their 'environmental worries', despite an explicit explanation of environment provided to them in the questionnaire preamble. As the aim of this question was to elicit concerns for the natural environment, these responses were excluded from the following analysis.

The two primary concerns of HH were recorded as deforestation (63%) and burning of forest (39%) (percentages sum to over 100 as HH reported more than one worry). Other concerns included soil erosion, overgrazing, and site-specific concerns such as loss of rain that combined, were mentioned in less than 7% of cases. Deforestation and burning of forest are not independent concerns; both are practised in order to clear land for agriculture and livestock rearing. Combining these concerns, the loss of forest area accounts for 93% of 'worries' over survey sites. Consistent with FG discussions, the reduction in natural areas appears to be the main concern of the BME population.

Causes of worry were more varied with some respondents giving proximate and others giving ultimate causes. The increased demand for cropland, grazing land, the need to protect livestock from wild animals, and collection of woody products for sale, were given as immediate reasons why deforestation and burning is occurring. Others stated that population increase and lack of jobs, money and education had increased reliance on the agro-pastoral livelihood explaining how they believe these destructive practices came to be (see Appendix 8 for a summary of reported environmental concerns and causes).

LAND RANKING

HH were asked to rank land uses on the basis of the value they could potentially derive from five hectares. The questionnaire stated five land use types: natural forest, coffee land, irrigation land, cropland, and grazing land. Post data collection coffee and irrigation land were removed from the analysis as they are contained within other land uses (coffee land within natural forest, irrigation land within cropland). Ten HH from Hora Soba were discounted due to translator misunderstanding.

Mean rankings were consistent across the survey sites and overall cropland was ranked as most valuable (mean=1.2 ±0.04, n=185) followed by grazing land (mean=2.0 ±0.04), followed by natural forest (mean=2.66 ±0.05)(Figure 17). This is consistent with the pattern of land use change seen in the area, with conversion of forestland into agricultural and grazing lands.

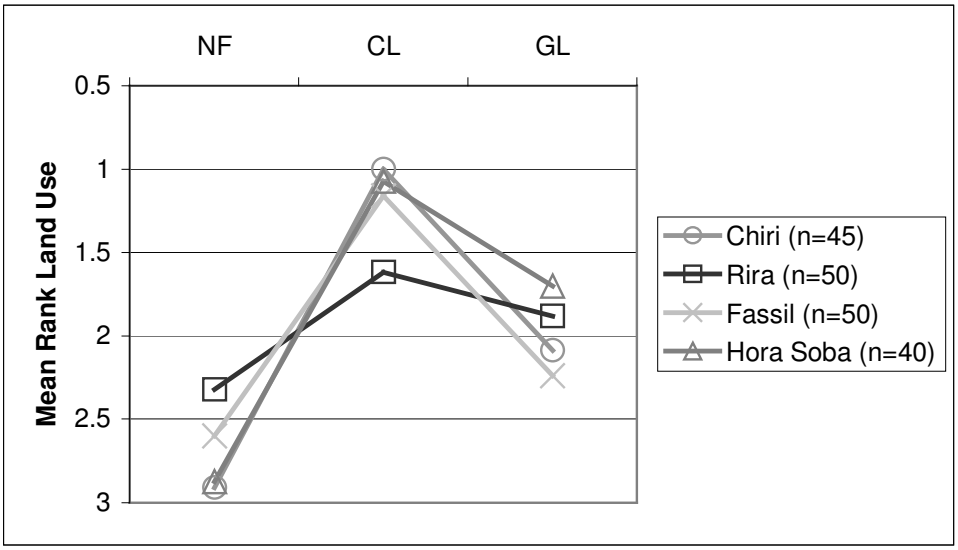

Figure 17. Mean rank of five hectares of land
(NF=natural forest, CL=crop land, GL=grazing land; 1 is most important)

Interestingly, the perceived order of value of land uses did not correspond with rankings of the actual value a HH derived from each land use. Simple correlations of cropland with crop value (r=0.0034, p=0.97), grazing land with livestock value (r=0.0758, p=0.35), and natural forest with combined forest product and construction material value (r=-0.0313, p=0.70), revealed no relationship between perceived and observed benefits (see Appendix 9 for cross-tabulations). However, by constraining the area of

land type it is incorrect to conclude that HH are unaware of the value they derive from land uses.

FOCUS GROUPS

Focus groups were conducted at all survey sites with 11 environment and general, and 12 crop and livestock productivity discussions completed. For each group between four and ten individuals were present and all participants were encouraged to share their opinion. The groups were highly male biased with only a single female group in Chiri, and difficulties gathering individuals led to completion of only a single crop and livestock productivity FG in Hora Soba.

The findings of the general and environment FG were fairly consistent across survey locations. When asked about the most important problems that people living in the area must deal with day-to-day, respondents commonly mentioned shortages of food, lack of health clinics and clinic manpower, and lack of education and job opportunities leading to poverty. Chiri was the only survey site to include environmental problems in these day-to-day issues. Loss of soil fertility and lack of access to clean drinking water was reported as well as the sole female FG reporting a shortage of firewood, with women travelling up to 4km each day.

When asked about the perceived quality of the environment Rira and Fassil inhabitants all reported good levels of quality however, Chiri inhabitants reported declining levels of quality particularly as a result of deforestation.

Discussion on activities undertaken in the environment that contribute towards wellbeing focused on labour activities in agriculture and livestock production. No groups mentioned ecosystem services or values other than direct use values, though it was recognised by all participants that the ecosystem was highly important in the maintenance of their livelihoods.

Changes in the immediate environment in recallable history at survey sites all resulted from increased encroachment of humans into natural areas, leading to either decreased forest density or receding forest boundaries. The distinction between man-made and natural environment does not seem to be pronounced in the BME, with FG participants

including the building of schools and attempts to introduce 'improved' crop and livestock varieties into the area as changes in the environment.

The findings from the crop and livestock productivity FG provided information on the inputs of HH crop and livestock production as well as market access and conflicts between humans and wildlife. Individuals take their own produce to market, with only a few products sold through middlemen. In Chiri coffee, in Rira skins of livestock, and in Fassil barley and shallots, were sold to traders rather than directly. Distance to markets ranged from local markets within survey sites to larger urban markets 65km from survey sites. Transport to markets was largely dependent on horse, donkey and mule power, with occasional paid transport by Isuzu truck and buses.

In Chiri and Hora Soba, conflicts with wildlife appear to be common. Monkeys, warthogs, nyala (see Figure 18) and insect pests are reported to damage crops, including the forest coffee in Chiri. While hyena and, in Chiri, lions, take livestock. Measures to prevent losses appear to be fencing of crops and fencing and/or guarding of livestock. In Fassil and Rira no losses of crops or livestock to wildlife are reported. Instead, conflict with nature appears to be too much rain spoiling crops and decreasing honey production through reduced flowering.

Figure 18. Mountain nyala (*Tragelaphus buxtoni*)
A type of antelope endemic to Ethiopia; it is listed as endangered by the IUCN.

DISCUSSION

This section first presents the findings of this direct consumptive use valuation by key ecosystem goods and services, by HH and at the BME level. It then evaluates the suitability of the methods employed in meeting the objectives of this research and the aggregation of the direct consumptive use value over the BME. It makes explicit the assumptions made in the valuation, firstly that the opportunity cost of HH labour is negligible and secondly, that the sample population is representative of the wider BME. It reviews the limitations of the valuation, specifically, the impact of the omission of environmental externalities in production and finally, areas of further research to advance resource management in the Bale Mountains are suggested.

SOCIO-DEMOGRAPHIC CONTEXT

The population of the BME is predominantly Oromo, the politically dominant ethnicity in the area. It is also young, with 60% under the age of 18. This is in-keeping with Ethiopia wide statistics reporting the median age of the population at 17.5 (IMF, 2007). Individuals contribute to HH activities from a young age and small children are frequently observed collecting water and tending livestock. This contribution to economic activity from an early age is likely to generate competition between time allocated to schooling and that allocated to HH labour. Less than 50% of the BME population are currently undertaking, or had completed, any form of education, supporting this generalisation. However, BME does not appear any less educated than the rest of the country with literacy across Ethiopia is estimated in 41.5% of adults (Economist, 2007). With the majority of the population rural it is likely that HH labour is perceived to be more productive than schooling. With scarce, highly competitive and principally male oriented job opportunities, HH see little benefit from paying to school children, a problem that can be exacerbated by the difficulties in access to schools in the rural settings.

A high level of concern for the environment exists in the BME, with 77% of HH with at least one environmental worry. The focus of these worries is the loss of naturally forested areas through clearing and burning of forest in order to acquire land for grazing and agriculture. In the BME community, there is a theoretical rejection of anthropocentric and selfish motivations to resource use. Instead community concern for

areas of forest that others may be utilising is widespread, as are non-use values. Existence values are held by 97% of HH and bequest values by 79%. However, when making trade offs and where day-to-day issues of health, poverty and education have to be met, these underlying motivations appear to be deserted. In general, it appears that the BME resources are understood to be very important to individuals, but are being destroyed due to a system of open access management with people were acting in their short-term and self-interest. As one Chiri respondent reported, "if they did not someone else would".

KEY COMPONENTS OF DIRECT CONSUMPTIVE USE VALUE

Crop agriculture and livestock management are the primary day-to-day activities within the BME with very few HH involved in trading or service provision. In addition to crop and livestock production, HH engage in the harvesting of forest products including firewood, materials for construction, and where local conditions allow it bee-keeping and the harvesting of forest coffee. In addition to these sources of direct use value residents also enjoy recreational benefits of the BME, although these are not considered by HH to be as important to wellbeing to those uses providing more immediate livelihood sustaining benefits, defined here the direct consumptive use values of ecosystem goods and services. As such it is reasonable to assume three principal sources of direct consumptive use value: the production of crops, livestock and the collection of FP.

This study assesses the value of ecosystem goods and services through the market values of both marketed and non-marketed products. These direct benefits are realised through high inputs of HH labour and low inputs of capital. HH livelihood strategies are shaped by ecological conditions caused by topographic variation, but reach a consistent level of wellbeing in spite of these variations. With the conservation of Bale's resources being promoted through BESMP and the BMNP GMP for the next ten years, the assessment of this value at the HH level will help predict how changing resource access and management strategies will affect rural livelihoods.

THE VALUE OF CROP PRODUCTION

The BME is a fertile area with high levels of rainfall relative to other parts of Ethiopia. These conditions lend well to crop growth and the Bale Mountains are commonly considered a 'rich' area of Ethiopia. Most HH grow more than a single crop type and this intercropping meets the varying HH needs as well as contributing to food security if one crop should fail. 96% of HH engage in crop production in the BME and the valuation of both the marketed and non-marketed crop production is estimated to contribute US$ 1157 to HH annually. The capital inputs required for crop outputs are found to be minimal. Fertiliser application was either absent, minimal or manure based. Seed costs are largely averted by collection of seeds from previous years or carry on small costs and irrigation schemes were not common. This value is almost three times as that found by Dovie *et al.* (2003) for South African HH crop production. However, comparisons are limited out of the original context due to the substantial differences in environmental conditions.

The direct consumptive use value derived from crop production is found to differ significantly between kebeles, with those at higher altitudes deriving higher value. The topographic variability of the BME climatically constrains the type of crops that can be grown by HH, with mazie, tef and fruits grown at lower altitudes and, barley and root crops grown at higher altitudes.

Of the direct consumptive use value derived from crops, HH sell an average of 45%. This proportion sold is composed of HH surplus or cash crops and is relatively high; marketed surplus across Ethiopia is estimated at only 15-20% of peasant farming (Abrar *et al.*, 2004). Despite this, traditional methods of farming are still relatively inefficient and lead to low crop yields. Government development and poverty alleviation schemes continue to work to improve agricultural productivity. Their recommendations focus on better soil management through rotations and increased yields using fertiliser and better crop varieties; part of the so-called agricultural development-led industrialisation (Pender & Gebremedhin, 2006). While intensification might reduce the encroachment of cropland into natural landscapes, there are likely to be negative longer-term environmental impacts to be assessed before these measures should be fully endorsed.

THE VALUE OF LIVESTOCK PRODUCTION

Livestock ownership is almost total in the BME, with 99% of HH keeping cattle, horses, donkeys, mules or smaller livestock such as sheep and goats. Animals are employed in a wide variety of uses including both destructive and non-destructive uses: meat, skins, milk products, transport, ploughing and reproduction. In contrast to prediction, the use of livestock for insurance, investment or social capital was not reported. The absence of this value is goes against previous findings of such values in Bale (BMDC, 2003a) and would be expected from the high rates of time preference found in Ethiopia (Pender & Walker, 1990; Holden *et al.*, 1998). It is possible that these values do exist even though they are not reported. The absence of this social use value may then be attributed to the apparent irrelevance of this value, by both questionnaire respondents and translator alike, to the questionnaire.

The capital inputs in the rearing and maintenance of livestock were found to be negligible. Additional feed was primarily in the form of salts, obtained inexpensively locally and further feed resulted from agricultural practices, and slaughter is preferential to treatment of sick animals even though annual vaccinations are available at low cost. Without data on grazing requirements of livestock types, this valuation relied solely on the live, marketed livestock produce. This HH income from livestock amounts to US$ 228 annually.

In light of numerous values derived by livestock, it is probable this significantly underestimates the private direct use value accruing to HH. With livestock value thought to comprise between 41% and 57% from draught power alone the private values could be three times that reported here. Although not included in this livestock figure, these additional values of draught power and transport should be represented in the market values of the crops and goods they ultimately produce and transport. Furthermore, substantial value can be derived year after year from animal reproduction and milk. Though we cannot estimate reproduction rates, milk yields were found to be in the range of 420 litres annually in the BME, giving a market value of US$ 139 at present market prices. Previous literature exploring the HH values of livestock, have tried to incorporate this multitude of livestock values. It is because of this and the wide variation of value derived from these studies it is not possible to make a value comparison.

As with crop production the direct consumptive use value of livestock is variable between kebeles. However, this difference is not so pronounced. Livestock are known to be more resilient to differences in climate and pastoral based systems are favoured in marginal environments with climatic uncertainty and low-grade resources (Davies, 2007). The differences observed are predicted to be a result of grazing differences in grazing quality between kebeles rather than differing economic incentives.

After a long period of unrestricted access to the Bale Mountains National Park, many HH are known to travel long distances to graze livestock here. With new management plans to exclude livestock from grazing within the habitats of the BMNP, this value estimation can inform decision-making. Despite not encompassing the full range of livestock uses, the assessment will inform the level of compensation, or alternative income sources that need to be provided to HH that no longer have access to grazing lands.

The Value of Forest Products and Construction Materials

Forest products were collected by all HH of the BME. A division of labour by sexes was observed in their collection, with firewood collected by women and children (74%) and forest products more physically demanding in their harvesting, gathered by males. Though many forest products were similar between kebeles, there were some locally specific products. Forest coffee was able to grow only in the lower altitude, warmer forests surrounding Chiri and extensive honey production, through bee-keeping activities, was only found in Rira. The time travelled to source these products are variable between kebeles, reflecting both the proximity to naturally forested areas and the products themselves.

The direct consumptive use value derived from marketed and non-marketed forest products annually was estimated at US$ 407 per HH. The majority of forest products did not require capital inputs and were more reliant on human knowledge and skills. Only bee-keeping required the creation of hives and these are traditionally built from bamboo and climber the collection of which is included in the forest product valuation. Comparison with existing literature is problematic in light of the range of forest product

definitions and methodologies applied. However, this value does fall within the range found by a meta-study of forest income (Vedeld, 2004).

Although HH reported the collection of medicinal plants it was not possible to attribute a value to them; many plant species are used as medicinal plants and without details of the plant species, amount and processing requirements of the harvested materials assessment would be unreliable and inaccurate. However, Bale has 337 plant species identified to have medicinal properties and with many HH too remote to access modern medicine, the value of these natural curative agents is predicted to be large. Mander *et al.* (2006), estimates the average Ethiopian HH expenditure on medicinal plants is over US$ 50 annually. However, it is unclear how much of this value is gathered and how much purchased by HH, as such unit benefit transfer of this studies findings has not been attempted. In light of this absent, but predicted significant, value of medicinal plants, the direct consumptive use value of forest products is likely to be an underestimate.

As with crops and livestock, a significant difference in direct consumptive use value of forest products was found between locations. As a result of the high value of forest coffee, Chiri derives a much greater value than the other kebeles. Rira and Fassil also have higher forest products values than Hora Soba. These differences are further emphasised by the differences also found in the value of marketed forest products between locations. On average 38% of forest products value is marketed but we see specialisation in a single marketed product at kebele level. In Chiri 97% of value sold is from forest coffee, amounting to US$ 550 per HH annually. In Rira, the sale of honey accounts for almost 100% of sold produce and in Fassil, 94% of sold value comes from firewood. This is in considerable contrast with Hora Soba where only 2% of forest products value is traded. This is likely to be due to the proximity to naturally forested areas, with Hora Soba surrounded by grasslands rather than forested areas.

In light of these high values for forest coffee and honey production there is potential to add value to these products. By adding value to this production, the income that HH receive could be increased. This would serve to reduce the human pressure on the BME goods and services through a lower level of resource extraction. Forest coffee and honey already have established markets in the BME so the improvement of these

markets is not a large step; even small changes in post harvest handling could add value to these products. If community based organisations (CBOs) could be successfully established for forest products there may also be potential for organic and fair-trade certification, raising the price premium and incentivising conservation of natural forest.

Forest coffee and honey aside, forest product type was largely consistent across the BME. Firewood is the most commonly reported forest product and is valued at over US$ 165 per HH annually. Firewood is an extremely important source of value to Bale's rural HH with alternatives, such as charcoal, kerosine, electricity, or liquefied petroleum gas, expensive to acquire. With a rising population the demand for wood based fuels to meet energy needs will also increase.

The valuation of natural materials used in the construction of HH was simple. HH form is consistent across the BME and as expected there were no significant difference in construction value between kebeles. A traditional house was valued at US$ 138 on the basis of the wood, climber and grass used to construct it. These structures are subject to harsh weather conditions and are likely to need to be maintained. However, as they are made of natural products the value of these maintenance materials will be included in the valuation of harvested forest products. In order to calculate the value annually HH were asked to report expected construction longevity. The resulting large variation in responses despite consistency in structure suggests that future valuation could increase the accuracy of this estimate though independent assessment of the structure and degeneration of constructions.

THE RELATIVE CONTRIBUTIONS TO DIRECT CONSUMPTIVE USE VALUE

The aggregate direct consumptive use value, provided by ecosystem goods and services annually, is estimated to be US$ 1823 per HH. Over two-thirds of this value derives from crop production (65%), only 13% from livestock production and 21% from forest product harvesting. This HH value is found to correlate positively with the number of people reported to live within a HH and negatively with the number of uneducated people. This suggests the availability of HH labour is a limiting factor in HH production, and also that even a low level of education can result in better management and increased productivity.

The values found in this study are similar to that found by Dovie *et al.* (2005) in South Africa. Based on agro-pastoralism and secondary woodland resources they found annual HH income to be US$ 1660, though the reliance on livestock was much higher (40%) and that from crops lower (27%) than observed in the BME. They also find a positive correlation to the number of people, and also the number of women in a HH. The difference between relative reliance on livestock and crop production between studies are quite pronounced, but it appears that the proportion of value derived from forest products is consistent with a meta-study revealing HH income from forest products at 22% of HH income (Vedeld, 2004).

Despite the observed local variations in direct use values derived from these principle components, it was found that the aggregated HH value is not significantly different between kebeles. These findings suggest a baseline level of goods and services are needed to sustain a certain level of wellbeing, or a subsistence level. In order to meet this subsistence level HH value is derived from the three key components, crops, livestock and forest products, according to the local environmental conditions. Production decisions are based on the differing climate and soils between locations, as well as the access to arable land. Where land is unsuitable for ploughing and crop growth, HH may rely more heavily on livestock production, or where access to grazing lands is limited, forest products can be relied upon instead. Chiri exemplifies this, as the presence of forest coffee is such a substantial source of value that HH rarely report any secondary work activities after agriculture, within which they include the harvest of forest coffee, and derives the lowest value from both livestock and crop production. The livelihood strategies of communities are therefore, a balance of the principle components of direct consumptive use value according to particular availability of natural resources; the divergence of relative value is ecological rather than economically based.

In light of the significant lack of job opportunities in the BME, the economic value derived from the three component assessed in this study is likely to comprise the complete income of the HH economy. Although, other sources of income such as remittance money must be assessed before we can firmly conclude that this is fully representative of the HH economy. Assuming that this is an adequate representation, the consistency of the estimated direct consumptive use value over locations suggests

that this is the economic value required for a HH to make ends meet. With the observed high rates of time preference due to lack of saving and investment opportunities, this would be rational as there is no incentive for the HH to produce more than required to cope from year to year.

With such a balance between the components of direct consumptive use, it was expected that HH would be aware of the relative contribution of crops, livestock and forest products to their HH. However, the actual value that HH obtained from the components of direct consumptive use did not correspond with the perceived contribution of land uses. The result is surprising in light of the decisions that must be made to appropriately allocate HH labour time. This could suggest a lack of awareness within the BME communities. However, the flawed phrasing of the question, realised *post-hoc*, does not validate such a conclusion. Restricting the area of land to be ranked but comparing undefined areas utilised by HH, assumes incorrectly, that areas of land use types are equivalent.

Looking more closely at the average income derived from marketed products, HH receive US$ 904 annually. In-keeping with our subsistence theory, the sale of this value will be used to purchase basic HH expenses such as additional food, clothing, medical fees, school fees, household utensils, and transport fees; as well as expenses for social obligations such as: community contributions, tax payments and ceremonial expenses. A study by BMDC (2003b) estimated these HH expenses at over US$ 250 annually, which can be comfortably covered by the average value of marketed produce.

DIRECT CONSUMPTIVE USE VALUE OVER THE BME

The BME community is estimated as a population of 1,502,506 people. Assuming nationwide statistics the number of rural dwellers is 1,277,131 (85%). Scaling up over this rural population, the BME provides a local annual flow of directly consumptive ecosystem goods and services of **US$ 377,777,500**. This is a substantial value, demonstrating the largely unaccounted for benefits that arise in the BME. The benefits accruing to the urban population were not assessed in this study. However, observations reveal that even living in more urban areas do own livestock and some HH do still collect firewood and forest products. This means this figure is a lower bound estimate of the private values on account of the conservative methodologies employed.

ASSUMPTIONS AND APPLICABILITY OF METHODS

This study employed market value methods in order to estimate the magnitude of the direct use benefits accruing to the BME communities from ecosystem goods and services. By using market prices the preferences of individuals are observed directly. This WTP for a marketed product or the WTP for a marketed, near perfect, substitute, is used to calculate the value of the HH marketed and non-marketed produce.

This use of market prices is widely acceptable and understood, measuring the value of the product under current demand. This measure of the actual value derived from ecosystem goods and services is more relevant than a measure of the potential benefits, as it allows the assessment of the present use and implications of declining benefits or restrictions on use. It also means that there is no concern of a change in preferences if there were to be an increased supply of goods. The production, marketing and use of goods valued in this study are well established in the region. With HH taking their own products to market and large numbers of unrestricted sellers, there are no observed monopolies or marketing costs and it is fair to assume competitive market prices. As we are observing market-clearing prices the value does not include consumer surplus, and since this method does not establish a demand curve we cannot estimate this additional value. As such the market price is only a lower-limit estimate of the total value of the commodity to the individual and consequentially, our estimate of value is conservative.

A limitation in applying this market price based method is that the valuation is static. The preferences for market goods are measured at a single point in time. Seasonally and in the future, the preferences of the HH of the BME might change. In particular, the value minor forest products may change seasonally, and the prices assessed here are representative of only one season. However, the forest products valued in this study are largely non-perishable with the most valuable, forest coffee and honey, able to be kept for long periods. A seasonal variation might instead be observed in crop prices by season and should be investigated further. In the longer-term, changing preferences could result from increasing scarcity or limited availability of goods and services, but will also result from changing trends in population, technology, income and societal influence (Lampetti & Dixon, 1995). For example, it was noticed that there is a growing

trend replacing corrugated metal for doors and roofing. Market prices will therefore have to be reassessed at intervals in order for valuation to continue to be valid.

Opportunity Cost of Household Labour

The benefits provided to HH of the BME through crops, livestock and forest products are only available through the investment of human inputs. In order to quantify the value provided only by the environment it was necessary to assess these inputs, the largest of which was that of HH labour. In order to value the opportunity cost of labour, focus groups were conducted to discover a minimum wage rate. These focus groups revealed that job opportunities in rural areas were extremely limited, generated only meagre wages, and available only to males. As such, value of this labour input could not be assessed and the costs of HH labour were assumed to be negligible.

This is a major assumption, as even with no prospects of employment an individual would have to be fulfilling no other useful HH tasks to say that no output is forgone in one productive activity. This allocation of time between HH tasks may have implications for value generation in the BME. Bandyopadhyay *et al.* (2006) found that HH might forgo additional crop production if the distances to fundamental energy sources, such as fuelwood are too high. However, unable to attribute value to HH labour, assuming that labour costs approach zero and making this assumption clear, is better than misattributing a value.

In the future, job opportunities and so the opportunity costs of labour are likely to rise; the World Bank are funding a project to asphalt the poor condition road linking Bale to the road infrastructure of Ethiopia that will bring increased investment and tourism. Furthermore, the absolute amount of labour is likely to increase with continuing ecosystem degradation. Inputs of time to crops will increase as soil quality declines, the distance to suitable grazing lands for livestock will increase, and deforestation will increase time to forest products sources. In future, it is therefore necessary to find a way to better assess the opportunity costs of labour.

The complexity of ecosystem goods and services can lead to problems of aggregation where the benefits are interlinked and where the scale of aggregation is not properly considered. This study made efforts to ensure that connected benefits were not double counted. For example, the crop products valued were only those of human consumed yield and not that used for livestock feed, livestock contributions to crop value through ploughing, threshing and in the transport of goods to markets is contained within crop value, and the materials used for maintenance of HH structures not valued in addition to annual forest product collection. The BME covers an area of 22,176 km^2 and with a fluctuating topography the BME contains a range of habitat types that exceed the number of survey sites study. As indicated by these findings, the resulting local conditions lead to variations in the relative reliance of HH on crop production, livestock rearing and forest product harvesting. In spite of this, we can still scale up this value over the entire rural BME population with a degree of confidence in light of the discovery of a subsistence level of HH value. An extension of this study into less central regions of BME would be able to corroborate or reject this assumption. Of particular interest would be survey of kebeles that are thought to specialise in particular key goods such as Sheddem, from where marketed bamboo is sourced.

With a population of over 1 million, the scale of value aggregation in the BME is high. In order to be confident in the final estimate of direct consumptive use value, the sample population must be representative of the wider eco-region. The socio-demographic information collected in the HH questionnaire appears to conform to expectations with a 50:50 sex ratio and similarities with existing literature, but this data is also gender bias and does not sufficiently measure the levels of polygamy in the BME.

This data reflects the attitudes and motivations to resource use of the male population. The largely male dominated culture and history of Ethiopia was evident in the attempts to conduct female focus groups, and the total male bias in the HH questionnaire. The absence of the female perspective in could obscure important issues, especially as a division of labour by gender is observed in HH. For example, the single female focus group highlighted the increasing distance travelled to collect firewood that did not arise elsewhere in this research. While these gender issues should be researched further in order that management reflects all HH needs, this is unlikely to have an impact on the

value estimation with the return to productive HH activities is unaffected by the gender of the respondent.

The finding that some HH heads were polygamous has introduced a margin of error into the value estimate. Polygamy provides a greater level of HH labour and allows a family to keep two houses in different locations, one nearer grazing areas and one closer to arable land. Despite the reference to a single HH in the questionnaire preamble, it is possible that productivity, or number of HH members might have been reported for multiple HH. Though not impacting on two of the kebeles surveyed, further research could discern the level of error in the results from Chiri and Hora Soba, and the level of polygamy across the BME. The inaccuracy in value estimates that this introduced could be as large as 20% in affected kebeles and without proper assessment this error could be compounded through aggregation. In general, the aggregation of the key components of direct consumptive use value for both the HH and the BME can be summed confidently. With care taken to avoid known pitfalls and conservative methodologies used throughout. However, we must be cautious of the conclusions that we make in light of the unknown HH dynamics of polygamy.

Environmental Externalities of Land uses

The environmental conditions supporting the flow of benefits are common property and open-access, and in combination with a growing population there is likely to be increasing demand on the natural resources of the BME. While this valuation demonstrates the substantial private direct use value that HH obtain from the environment, it does not assess the social costs of the practices, or establish how sustainable this level of resource extraction is.

The externalities of crop production are often unintended, indirect or diffuse and only perceptible over a long period of time (Bishop, 1995). However, the impacts on the environment can be local or far-reaching with the effects of soil erosion, sedimentation and leaching, affecting hydrological systems. The negative externalities from agriculture are already observed in BME as the destruction of natural forest for arable land. The externalities from livestock production are also thought to be substantial including, increased run-off, reduced ground water recharge, changes in vegetation, soil erosion and the disappearance of wildlife (Arntzen, 1998). However, there may also be several

positive externalities resulting from pastureland (Davies, 2007), and in Bale this may include, the fertilising properties of manure and the maintenance of grasslands for rodents and antelope. The harvest of forest products can also necessitate the destruction of natural areas and so have negative environmental impact. Within the National Park commercial extraction of bamboo poles can be observed and unregulated forest coffee extraction is also leading to the alteration of natural areas; understorey clearing and planting of coffee seedlings is observed in Chiri.

The environmental externalities of this agro-pastoral livelihood strategy are imposed both within and outside the BME, and the level of degradation is will be dependent on the land use, production technologies and livestock density. The omission of these environmental costs may mean that the direct consumptive value, though an underestimate from a private HH perspective, may be an overestimate from a social perspective. Therefore, the sustainability of the principle practices of obtaining value from the ecosystem need to be assessed.

This sustainability will have implications for the resource management of the area and for the long-term wellbeing of the BME communities. If the negative environmental externalities are too great, the degradation of the ecosystems ability to provide goods and services will increase the costs of traditional farming methods and there will be a commensurate increase in market prices. Further research could examine any trends in market prices to infer increasing scarcity and costs of production, or user costs could be incorporated into the valuation and subtracted from private benefits. With Ethiopian Federal government influencing the land use decisions of rural HH through incentives, laws, infrastructure and institutional arrangements this gap between private and social costs must be better assessed and accounted for in policy and sustainable development and poverty alleviation strategies.

FURTHER RESEARCH

This valuation study has highlighted a number of issues that warrant further research in order to advance the natural resource management in the BME. There are three key directions for this research, improving the methodology employed by this study, analysing issues brought to light by this study, and increasing the scope of this study to include other aspects of the TEV framework.

The methodology applied in this study could be enhanced by the assessment of the environmental externalities that are likely to occur under the traditional practices used in the realisation of value from goods and services. These could be substantial and without adequate assessment it is unknown if the flow of benefits from the resource environment system is sustainable. Furthermore, in order to corroborate the finding of a subsistence level of value independent of ecological conditions, the study area should be extended into the wider BME. The replication of the study will indicate if the current findings are reliable and will allow the better assessment of polygamy and seasonality in market prices.

In light of the division of HH labour by gender found in this study a more detailed investigation of time allocated to various HH tasks and the exploration of female attitudes to resource use would be beneficial. Through examination of HH labour it could be established if the dependency of HH on particular sources of value were a factor of HH demographics. Along with analysis of the distribution of value between households, this could benefit development and poverty alleviation goals by identifying marginalised members society. The societal groups identified in this process could then be targeted for schemes to add value to production and this, in itself, would require research into the various CBO types that have legal standing in Ethiopia and the institutional capacity required to support them.

In addition to the direct use value, there are many other values of ecosystem goods and services flowing from the BME that have not been quantified here. While this study will contribute to a TEV establishing the value of the BME as an environmental asset, the application of further environmental valuation methodologies will allow the quantification of other values predicted to be substantial. In particular, the indirect hydrological services of the BME support agriculture in the lowlands of Ethiopia and Somalia; the wetland areas of the BME hold indirect values from carbon sequestration; and the BMNP receives many national and international tourists enjoying direct recreational benefits each year. The quantification of the vast array of environmental values will provide further justification for the investment of resources in the conservation of the BME.

CONCLUSION

This study gives a valuable insight into the livelihood supporting, goods and services provided by the BME ecosystem. It highlights the considerable economic value that the environment contributes towards the local economy and, it is hoped, this direct consumptive use value will inform decisions and justify investments of financial resources to promote the more sustainable use of the Bale Mountains Eco-Region.

The conclusions of this research are summarised as follows:

- The HH of the BME are shown to derive considerable value from ecosystem goods and services in the form of crop production, livestock production and forest product harvesting. Crop production is valued at US$ 1157, livestock production at US$ 228, and forest product harvesting at US$ 407.

- It is found that the relative contribution of each of these principle sources of direct use value is variable between kebele locations. With a widely variable topography the HH are seen to be opportunistic to the prevalent ecological conditions, adjusting their reliance on the sources of direct value accordingly.

- The aggregated direct use value derived by HH is consistent between kebele locations and valued at US$ 1823 annually. In light of the scarcity of job opportunities in the BME, this represents the entirety of income in rural HH and suggests a subsistence level wellbeing. While ecological factors determining how HH allocate labour and capital to the principle sources of value, overall production meets a particular level of benefits. This produce can then be consumed at home, or sold in order to exchange for other basic HH necessities to secure this subsistence level of wellbeing.

- Despite pro-conservation attitudes of the BME residents, resource use is driven by motivation to meet this HH subsistence level. Important relationships are found between productivity and HH dynamics, with a positive correlation found between the number of people per HH and the direct consumptive value, and a

negative correlation found between the number of non-educated HH members and this value.

- Across the BME the collective direct consumptive use of ecosystem goods and services in the BME at US$ 377,777,500. This annual value derived by the permanent rural residents, represents the contribution to the local economy under current management and policy structures. The considerable magnitude of this value endorses the need for the investment of financial resources to reduce the degradation of environmental quality that is occurring over the BME.

This environmental valuation of the BME ecosystem goods and services advocates the adoption of conservation rationale based on human utility. It is hoped that by expressing direct consumptive use value in monetary terms, future resource management decisions in the BME will be able to make more informed and transparent choices. The BME communities are the primary stakeholders and they rely almost exclusively, on the environment for their livelihoods. This study furthers understanding of the underlying motivations driving their resource use and can be used to predict the impact of forthcoming changes in resource access. The subsistence benefits derived by the BME communities have been quantified and can now be utilised in conservation strategies that change the incentive structure of resource use. In order for conservation of this flow of ecosystem goods and services to be consistent with poverty alleviation and rural development goals, management efforts need to consider the needs of the residents in the context of local ecological conditions. With proper management, the concurrent advancement of both conservation and development goals is not an impossibility.

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APPENDIX 1: PROJECT STAFF

Location 1: Chiri (GPS co-ordinates: 37N 0585792 UTM 0708628)

Translator (HH Questionnaire) and Local Liaison Officer:
Mohammed Hussen (Diploma in Animal Production, Holeta College, Ethiopia).
Woreda Development Officer, Chiri

Translator (Focus Groups):
Girma Ayele (BSc Forestry, Wondo Genet College of Forestry, Ethiopia).
Woreda Development Facilitator, Mena (Farm Africa/SOS Sahel)

Location 2: Rira (GPS co-ordinates: 37N 0579210 UTM0747989)

Translator (HH Questionnaire and Focus Groups):
Bedri Jemal (BSc Crop Science, Jimma University, Ethiopia).

Local Liaison Officer:
Ahmed Nebiso
FZS Para Ecologist, Darwin Harenna Project

Location 3: Fassil Angesso (GPS co-ordinates: 37N0607934 UTM0768873)

Translator (HH Questionnaire and Focus Groups):
Bedri Jemal (BSc Crop Science, Jimma University, Ethiopia)

Local Liaison Officer:
Hassen Mohammed (Diploma in Animal Science, Holeta Agricultural College, Ethiopia)

Location 4: Hora Soba (GPS co-ordinates: 37N057658 UTM0786679)

Translator and Local Liaison Officer: Kemer Esma'el Aliyi
Rural Development Officer, Hora Soba

APPENDIX 2. FOCUS GROUP OUTLINE: GENERAL & ENVIRONMENT

[Read out] **"This is Charlie and I am** *(name of interviewer)***. She is from Imperial College University in London, England and I am from** *(where the interviewer is from).*

We are conducting a study into the economic benefits of environmental goods and services to the communities in this area. What we mean by environment is the land around you, the plants that make up the forest, the animals within the forest, the air, the water and everything natural. To do this we need to collect information about your environmental goods and services.

We measure economic value as an individual's preference for a good. In a market, value is measured as how much you want to pay for something. Value of the environment is about measuring the preferences of people for an environmental good. But unlike goods and services you find at the market, environmental goods and services are hard to describe and not always sold in markets. This is why we have come to talk about the environmental goods and services that you are familiar with.

This focus group concentrates on what you think about the environment in which you live. We would like to find out more information on how much the environment around you contributes to your well-being and livelihoods, what you think the condition of your environment is and whether there have been any changes in the natural environment around where you live.

Your information is very important to the study so please take time to think carefully and discuss openly your opinions before collectively coming to an answer. There are six separate questions and we will discuss one at a time. Feel free to ask questions at any time.

Q1. First of all I would like you to think about the most important things you think about day-to-day. Now I would like to you decide what are the five most important problems that everyone has to deal with.

[*For example: poverty, health, and education, getting enough food, environment, finding enough water, work opportunities*]

Q2. Think about the environment in which you are living and the nature around you, what different aspects of the environment come to mind? How good you feel the quality of these different environmental aspects are in this area, including water, air, soil, habitats for plants and animals?

[*Allow discussion, for example: there are lots of animals and plants, the water is safe to drink, the water supply is reliable*]

Q3. As a community, as households and also as individuals think of all the activities that are undertaken in the environment around. These can contribute to your livelihood and also your general well-being?

[*Try and elicit use and non-use values here*]

Q4. Thinking back as far as you can remember can you think of any changes in the environment in this area? If there were changes, what are they and how have they affected the people that live here?

Q5. Are there environmental and with natural resources subjects that worry you? If so, what do you think are the causes of these worries and what can stop you worrying?

[WORRIES *for example: loss of animals and plants, drinking water pollution, soil erosion, flooding, fire, increased human settlement, climate variations. Encourage them to think of the costs that have been incurred to them by the environment*]

[CAUSES *for example: household rubbish, crop growing increased, hydro-electric companies, tourists, businesses*]

Q6. Thinking about all the different ways that people use environmental goods and services in your community. How important do you think it is for the well-being and the livelihoods of the people that live here?

[*Provide examples of environmental services such as water, sun, nutrients in the soil, bees, plants for medicine, trees, air, place to relax, tourism opportunities, jobs, education, place for children to play...etc.*]

That is all of the questions that we have for you. Is there anything else you would like to share about the ways in which you benefit or the ways in which you lose out because of the environment?

Thank you for your time, we appreciate your help.

APPENDIX 3. FOCUS GROUP OUTLINE: CROP & LIVESTOCK PRODUCTIVITY

[Read out] **"This is Charlie and I am** *(name of interviewer).* **She is from Imperial College University in London, England and I am from** *(where the interviewer is from).*

We are conducting a study into the economic benefits of environmental goods and services to the communities in this area. What we mean by environment is the land around you, the plants that make up the forest, the wild animals within the forest, the air, the water and everything natural. To do this we need to collect information about your environmental goods and services.

We measure economic value as an individual's preference for a good. In a market, value is measured as how much you want to pay for something. Value of the environment is about measuring the preferences of people for an environmental good. But unlike goods and services you find at the market, environmental goods and services are hard to describe and not always sold in markets. This is why we have come to talk about the environmental goods and services that you are familiar with.

This focus group concentrates on crops and livestock. We would like you to think about the different types of crops and livestock that are currently found in your community. We also want you to think about the how you manage crops and livestock as an individual's time is valuable and time spent doing one thing leaves less time to do something else.

Your information is very important for the study, so please take time to think carefully and discuss openly your opinions before collectively coming to an answer. There are six separate questions and we will discuss one at a time. Feel free to ask questions at any time.

Q1. (a) Households here often grow crops and we would like you to explain what the purpose of each type of crop is, for example, household consumption, for sale at markets, for sale locally or for animals, and the inputs that are required to grow these crops. Your inputs could include, for example, seeds, fertiliser, time is spent collecting water, generally tending the crops and employment of people to help manage crops.

Crop Type	Crop Purpose	Seed cost (ETB)	Seed needed to plant one ha	Fertiliser used (unit)	Who manages crops?	Amount of time spent daily.	Employment?	Equipment Required? Is it shared, made etc.

[*Example crops: cereals (Maize, wheat, barley, teff, sorghum); pulses (haricot bean (boloke), pea (ater), horse bean (bakela); root crops (potatoes, sweet potatoes); chat; coffee; fruits (banana, tomato); enset*]

(b) Could you tell me about any irrigation schemes that are used in this community, how they are designed and managed?

Q2. (a) Households here also have livestock and we would like you to explain what the purpose of each type of animal is, for example, household

consumption, for sale at markets, or for sale locally. As before, we also need to calculate the efforts you put in to caring for the livestock and these might include the initial investment, the costs of medicines or feed in addition to grazing, time spent collecting water for livestock or taking livestock to water sources and whether anyone is employed by livestock owners to help manage the animals.

[*For example: Cows, Bulls and Oxen, Heifer, calves etc, Sheep, Goats, Mules, Horses, Donkeys, Camels*]

Livestock Type	Purpose	Initial cost (ETB)	How many years do they last?	Medicine	Additional costs of feed (not grazing)	Who manages livestock?	Equipment Required? Is it shared, made etc.	Employment?

(b) We would like to know more about how far you travel at each time of year to find grazing land for livestock, this can tell me which areas contribute to your livelihoods and well-being. Thinking about each season how far would owners travel in each direction, North, South, East, West to find grazing land and in this time who looks after the animals?

Season	Info on grazing area – distance travelled
September to November	
December to February	
March to May	
June to August	

[*Get measurement in hours and also in km*]

Q3. Some crop produce and livestock are kept for household use and sometimes crop produce and livestock are sold. If you wanted to sell crops or livestock products from this area how would you get your products to a market?

[*Is a middleman required? does this mean that prices are different to if they sold it directly?*]

Product	Name of Market	Distance to Market	Transport to Market	Middleman required?	Additional Information

Q4. In many cases man faces conflicts with nature and the environment and this is can change the productivity of land for crops and livestock. In this area do you know about are any conflicts with nature or wildlife and human use of the land, and if so to what amounts are of crops and livestock are lost each year?

[*For example, crop yield is lost to birds, insects, and wild animals and livestock are lost to disease, drought, and wild animals*]

Q5. Doing one thing leaves less time to do other activities and an individual's time is valuable. So we would like to find out about the different types of work

activities that are available to all groups of people that live in your community. Please think of all the different types of groups: children, women, men and old people, and how they spend their time.

(a) What are the five most popular work activities of each group mentioned?

Group of people	Children	Women	Men
1 (most common)			
2			
3			
4			
5 (less common)			

(b) For the work activities you have mentioned that generate a wage, please can you estimate the daily wage rate that would be earned by doing this activity.

Q6. Lastly, land can be used in many different ways. We have so far talked about land for growing crops and land for grazing livestock. Another type of land is natural forest. To the communities in this area, which of these three types of land is most valuable to you and why?

That is all of the questions that we have for you. Is there anything else you would like to share about the ways in which your community manages their time and effort, or about how people living here make a livelihood?

Thank you for your time, we appreciate your help.

APPENDIX 4. HOUSEHOLD QUESTIONNAIRE

Interviewer:	Time of interview start:
Interview Area/Location:	Time of interview end:
Date:	Total time taken:
Interview Number:	

[Read out] **"This is Charlie and I am** *(name of interviewer)***. She is from Imperial College University in London, England and I am from** *(where the interviewer is from).*

We are conducting a study into the economic benefits of environmental goods and services to the communities in this area. What we mean by environment is the land around you, the plants that make up the forest, the animals within the forest, the air, the water and everything natural. To do this we need to collect information on the your use of environmental goods and services.

We measure economic value as an individual's preference for a good. In a market value is measured as how much you want to pay for something. Value of the environment is about measuring the preferences of people for an environmental good. But unlike goods and services you find at the market, environmental goods and services are hard to describe and not always sold in markets. Therefore we need to ask you about all the environmental goods and services you use such as water for your crops and livestock, medicinal plants from the forest, and building materials.

Money is the most convenient way that people express value so that is why we are collecting data on products that you sell. This will help estimate the value of natural resources to the people living in these areas.

[Ask if they are happy to continue with the survey. If yes, then continue, if no thank them for their time]

[Read out] **"Your answers will remain anonymous to other community members. If you do not wish to give your name you do not need to.**

Throughout this questionnaire we will refer to the "household". By this we mean all the people that normally eat and sleep under this roof. Please bear this in mind when answering questions."

PART 1 - Attitudinal, Behavioural and Perceptual Information

1. In our day-to-day lives we do many things, some things more often than others. These activities may be for pleasure, for work or for employment to earn money. Thinking about everyone that lives in your household, which of the following activities do they take part in and how often? [*Read out the activities one by one*]

Activity	How often (tick one only)?				
	Not at all	Once a year	Once a month	Once a week	Every Day
Harvesting fruits and plants					

for food					
Fishing for food					
Hunting Wild animals for food					
Collecting firewood					
Beekeeping					
Collecting Medicinal Plants					
Watching wildlife					
Children Play outside					
Outdoor Religious or Cultural activities					
Camping for fun					

2. Thinking about the same activities, rate how much they benefit you in terms of your generation of food, money and a general feeling of happiness and health (1 is very important and 5 is not important at all). [*Read out the activities one by one*]

Activity	Rate from 1 to 5
Harvesting fruits and plants for food	
Fishing for food	
Hunting Wild animals for food	
Collecting firewood	
Beekeeping	
Collecting Medicinal Plants	
Watching wildlife	
Children Play outside	
Outdoor Religious or Cultural activities	
Camping for fun	

3. We would like to determine the way people feel about the environment in which they live and work. We will read a statement out to you and would like you to decide if you agree with what has been said (you think it is true), disagree with what has been said (you think it is untrue), or that you do not know.

a. If no one uses a natural area it does not matter whether it has lost its forest or not.

agree / don't know / disagree

b. If a natural area that **I** do not use loses its forest, I am not concerned that others will not be able to use it.

agree / don't know / disagree

c. It is worth the Ethiopian government spending more money to look after natural areas as they are as it attracts new business to the area.

agree / don't know / disagree

d. Even if I don't use some natural resources now **I** would still like them to be available in case I want to use them in future, even if that means I have to forgo some benefits of natural resources now.

agree / don't know / disagree

e. People have a responsibility to protect forests and natural areas for our children and our children's children, even if that means we have to forgo some benefits of natural resources now.

agree / don't know / disagree

f. The fact that some animal and plant species may disappear from the Bale Mountains and Ethiopia due to loss of the natural areas is a serious problem.
agree / don't know / disagree

g. The quality of natural areas should be maintained only if the costs to people are not very high.
agree / don't know / disagree

h. People have more important things to worry about than the quality of the natural resources.
agree / don't know / disagree

4. a. Is there anything about the environment and what is happening in it now that worries you? *Yes/No/don't know*
If yes,
b. Describe the problem and why it worries you.
c. What do you perceive as the causes for these environmental problems?

PART 2 – Household Crops and Livestock

a. Did your household harvest crops last year? *Yes/No/don't know*

[*Example crops: cereals (Maize, wheat, barley, teff, sorghum); pulses (haricot bean (boloke), pea (ater), horse bean (bakela); root crops (potatoes, sweet potatoes); chat; coffee; fruits (banana, tomato); ensel*]

b. If yes [*ask to list all crop types first, and then ask to complete the rest of the table*]:

Crop type	Purpose (for HH to eat, to sell, for livestock)	Last years yield from first crop (Qt)	Last years yield from second crop if any (Qt)	Amount sold each year (Qt)	Price per (ETB)

6. a. Does your HH own livestock? *Yes/No/don't know*
b. If yes:

Livestock Type	Number owned	Purpose (to eat in HH, to sell, to possess for social capital)	Amount sold or traded (year)	Price of unit sold

7. Where do you graze your livestock in:
[*For example: Cows, Bulls and Oxen, Heifer, calves etc, Sheep, Goats, Mules, Horses, Donkeys, Camels*]

a. DRY SEASON
b. WET SEASON

8. a. Do you provide your livestock with additional food than grazing? *Yes/No/don't know*

b. If yes:

Livestock Type	Type of feed	Source of feed

PART 3 - Forest Products & Water Consumption

Natural Products:

9. Take your time to think back over the past year. Which of the following products do you remember your household collecting from natural areas? Please try to think of all natural products that you use including materials from which you make handicrafts, such as baskets.

Product	Amount collected last year	Purpose	Who collects? children/ women/ men /elderly	How far do you travel from your house? (hours)	Amount sold (record units)	Price of unit (ETB)
Plants for fences						
Climbers						
Bamboo						
Mushrooms						
Firewood						
Medicinal Plants						
Grass						
Wild meat						
Fish						
Honey						
Other.....						

Water Consumption (crops/livestock/cooking/drinking/washing):

10. a. What sources of water does your household use for cooking, drinking and washing?
[*For example: spring, river, pond, lakes, traditional boreholes, drilled borehole, and rain*]

Source	Estimated distance to source (time) **wet season**	Who collects? *Children/Women/Men/All*	Estimated distance to source (time) **dry season**	Who collects? *Children/Women/Men/All*

11. a. Do you filter your water to remove sediment before drinking or cooking with it? *Yes/No/ don't know*
If yes,
b. How do you filter your water?

12. What sources of water does your household use for crops?

Source (e.g. rain, well, river)	Estimated distance to source: **wet season**	Who collects? *Children/Women/Men/All*	Estimated distance to source: **dry season**	Who collects? *Children/Women/Men/All*

13. a. Do you have an irrigation scheme for your crops? *Yes/No/don't know*
If yes,
b. How was it built and how is it maintained?

14. What sources of water does your household use for water for livestock?

[*For example: spring, river, pond, lakes, traditional boreholes, drilled borehole, and rain*]

Source	Estimated distance to source: **wet season**	Who collects? *Children/Women/Men /All*	Estimated distance to source: **dry season**	Who collects? *Children/Women/Men /All*

15. Please select which best describes how reliable all your water sources are:

all year plentiful/ all year limited/ seasonal but plentiful/ seasonal and limited

Part 4 – Environmental Benefits of the natural areas

16. The land around us can be used in many different ways. Thinking about 5 ha of land, which of the following do you think people can get most value from (1 is highest value, 5 is lowest value)?

Land Use	Rank
Natural Forest	
Coffee Land	
Irrigation Land	
Crop Land	
Grazing Land	

PART 5 - Household (HH) Composition

In this last section we would like to get some information about people in your household and the buildings of your household.

17. Your role in the household [*For example; head of household, member*]
18. Total number of people in your household:
19. Ethnicity of your household:

Oromo/ Amhara/ Other (please specify).....

20. Household composition:

Age			Number of each sex		Education Level					Primary Work Activity	Other significant work activities
10 or less	11 to 18	19 or over	Males	Females	None	G1-6	G7-10	G11-12	G12+		

21. Thinking about all of the buildings in which your household lives, can you tell me about what they are made of?

Structure (e.g. walls, roof, doors)	Construction material	Source of material	Amount of material required (units)	How long does it last (years)?

[Read out] **"Thank-you for completing the questionnaire. With the data you have provided we can add up all the benefits provided to the communities of the Bale Mountains to estimate the total economic value of different environmental goods."**

[Write down time of completion]

APPENDIX 5. CROP TYPE AND PRICE SUMMARY

Crop Type	Location				Seed Cost[◊] (ETB per kg)	Market Price	
	Chiri	Rira	Fassil	Hora Soba		Price (ETB)	Unit
Avocado	●				-	393.8	100kg
Banana	●				-	312.5	100kg
Barley	●	●	●	●	1.77	197.8	100kg
Bean		●	●	●	3.03	320.3	100kg
Beetroot		●	●		0.40	302.9	100kg
Cabbage		●	●	●	0.54	226.4	100kg
Carrot		●	●	●	0.33	371.4	100kg
Chat	●				-	164.8	bunch
Garlic		●	●	●	6.20	1625.0	100kg
Guava	●				-	60.0	100kg
Haricot Bean	●				5.00	320.3	100kg
Lemon	●				-	53.3	100kg
Maize	●	●			2.00	142.5	100kg
Mango	●				-	335.7	100kg
Oat			●		1.47	227.5	100kg
Oilseed	●			●	5.00	540.8	100kg
Onion	●	●	●		0.79	627.3	100kg
Papaya	●				-	150.0	100kg
Peas		●		●	4.10	448.9	100kg
Pepper	●				-	681.3	100kg
Potato		●	●	●	0.98	157.1	100kg
Sorghum	●				1.42	160.9	100kg
Sugarcane	●				-	1	piece
Sweet Potato	●				25.00	144.1	100kg
Teff	●				3.33	371.4	100kg
Tomato	●				-	589.3	100kg
Wheat	●	●	●	●	2.67	265.0	100kg

[◊] Seed costs estimated through focus group averages. All prices are local varieties not improved stock.

APPENDIX 6. LIVESTOCK TYPE AND PRICE SUMMARY

Livestock Type	Location				Average HH Number	Longevity (years)	Market Price[◊] (ETB)	Livestock Output						
	Chiri	Rira	Fassil	Hora Soba				draught power	sell	reproduction	transport	meat	milk	eggs
Bull				●	0.0	5	2750[♦]	●	●					
Calf	●			●	0.4	11	663		●	●				
Chicken	●	●	●	●	2.5	4	16		●	●		●		●
Cow	●	●	●	●	7.2	11	1684		●	●		●	●	
Donkey	●	●	●	●	0.6	19	646			●	●			
Goat	●	●	●	●	2.6	8	150		●	●		●	●	
Heifer	●	●	●	●	2.8	5	1364		●	●				
Horse		●	●	●	2.2	22	1431		●	●	●			
Mule	●	●	●	●	0.1	27	2643[♦]				●			
Oxen	●	●	●	●	2.3	9	2636	●	●	●				
Sheep	●	●	●	●	11.8	7	369		●	●		●	●	

◊ All prices are local livestock, not improved stock
♦ Prices estimated from focus groups

APPENDIX 7. FOREST PRODUCT SUMMARY

Forest Product	Survey Site				HH	Labour▲								Time to Source (hours)	Market Price	
	Chiri	Rira	Fassil	Hora Soba		a	c	m	m & c	m & w	w	w & c	Unknown		Price (ETB)	Unit
Bamboo	●	●	●	●	74	0	0	74	0	0	0	0	0	3	22.7	Donkey
Climber	●	●	●	●	130	3	0	117	6	**2**	0	0	2	1.9	19.4	Donkey
Coffee◊	●				45	-	-	-	-	-	-	-	45	-	1928	100kg
Fence	●	●	●	●	124	2	0	118	1	2	0	0	1	2.2	22.9	Donkey
Firewood	●	●	●	●	191	9	3	11	0	25	69	72	2	2	17.1	Donkey
Grass	●	●	●	●	74	0	0	35	0	14	20	5	0	1.6	15.4	Donkey
Honey	●	●	●	●	94	0	0	94	0	0	0	0	0	3.7	1220	100kg
Medicinal Plants	●	●	●	●	77	7	0	34	0	33	0	0	3	0.6	-	-
Wood	●		●	●	9	0	0	7	0	0	0	0	2	0.2	27.8	Donkey

▲ a=all, c=children, m=men, w=women

◊ Forest Coffee reported as a crop and therefore data deficient

APPENDIX 8. ENVIRONMENTAL CONCERNS: DESCRIPTION AND CAUSE

Environmental Concerns by Location

Description of Worry	Overall	Chiri	Rira	Fassil	Hora Soba
Deforestation	**0.63**	1.00	0.22	0.46	0.70
Soil Erosion	**0.03**	0.03	0.00	0.00	0.07
Overgrazing	**0.02**	0.03	0.00	0.00	0.04
Burning Forest	**0.39**	0.00	0.78	0.59	0.30
Loss of Rain	**0.01**	0.00	0.00	0.00	0.04
Hunting Wildlife	**0.02**	0.00	0.00	0.00	0.07
Cause of Worry					
Increase in Cropland	**0.27**	0.50	0.00	0.03	0.52
Increase in Grazing Land	**0.09**	0.00	0.06	0.19	0.07
Insects/Animals	**0.13**	0.00	0.28	0.22	0.07
Population Rise	**0.05**	0.00	0.17	0.00	0.11
Sale of Firewood/Timber	**0.21**	0.00	0.00	0.41	0.30
Lack Gov Help	**0.01**	0.03	0.00	0.00	0.00
Lack Education	**0.08**	0.27	0.06	0.00	0.00
Lack Jobs	**0.19**	0.70	0.00	0.00	0.00
Lack Money	**0.16**	0.60	0.00	0.00	0.00
Lack Electricity	**0.01**	0.00	0.06	0.00	0.00
Don't Know	**0.13**	0.00	0.39	0.19	0.00

Proportions sum to more than 1 as more than one description/cause was recorded per respondent

APPENDIX 9. LAND VALUE RANKING CROSS TABULATIONS

Cropland vs. HH crop value

		Perceived Rank			
		1	2	3	Total
HH Value Rank	1	91	11	6	108
		57.96%	7.01%	3.82%	68.79%
	2	32	3	2	37
		20.38%	1.91%	1.27%	23.57%
	3	10	1	1	12
		6.37%	0.64%	0.64%	7.64%
	Total	133	15	9	157
		84.71%	9.55%	5.73%	100%

Figures show Frequency and Percentage of Rankings

Grazing land vs. HH livestock value

		Perceived Rank			
		1	2	3	Total
HH Value Rank	1	4	5	2	11
		2.55%	3.18%	1.27%	7.01%
	2	13	50	14	77
		8.28%	31.85%	8.92%	49.04%
	3	9	48	12	69
		5.73%	30.57%	7.64%	43.95%
	Total	26	103	28	157
		16.56%	65.61%	17.83%	100%

Figures show Frequency and Percentage of Rankings

Natural forest vs. HH FP and construction material value

		Perceived Rank			
		1	2	3	Total
HH Value Rank	1	2	6	30	38
		1.27%	3.82%	19.11%	24.20%
	2	3	11	29	43
		1.91%	7.01%	18.47%	27.39%
	3	6	13	57	76
		3.82%	8.28%	36.31%	48.41%
	Total	11	30	116	157
		7.01%	19.11%	73.89%	100%

Figures show Frequency and Percentage of Rankings